COMPLETED
1051-H-41
3.N88:53/0005

NUREG/IA-0005

International Agreement Report

Assessment of RELAP5/MOD 2, Cycle 36, Against FIX-II Split Break Experiment No. 3027

Prepared by
J. Eriksson

Swedish Nuclear Power Inspectorate
P.O. Box 27106
S102 #52 Stockholm, Sweden

ORIGINAL

Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

September 1986

Prepared as part of
The Agreement on Research Participation and Technical Exchange
under the International Thermal-Hydraulic Code Assessment
and Application Program (ICAP)

Published by
U.S. Nuclear Regulatory Commission

BEST COPY AVAILABLE

NOTICE

This report was prepared under an international cooperative agreement for the exchange of technical information. Neither the United States Government nor any agency thereof, or any of their employees, makes any warranty, expressed or implied, or assumes any legal liability or responsibility for any third party's use, or the results of such use, of any information, apparatus product or process disclosed in this report, or represents that its use by such third party would not infringe privately owned rights.

Available from

Superintendent of Documents
U.S. Government Printing Office
P.O. Box 37082
Washington, D.C. 20013-7082

and

National Technical Information Service
Springfield, VA 22161

BEST COPY AVAILABLE

NUREG/IA-0005

Assessment of RELAP5/MOD 2, Cycle 36, Against FIX-II Split Break Experiment No. 3027

Prepared by
J. Eriksson

Swedish Nuclear Power Inspectorate
P.O. Box 27106
S102 52 Stockholm, Sweden

Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

September 1986

Prepared as part of
The Agreement on Research Participation and Technical Exchange
under the International Thermal Hydraulic Code Assessment
and Application Program (ICAP)

Published by
U.S. Nuclear Regulatory Commission

I

BEST COPY AVAILABLE

NOTICE

This report documents work performed under the sponsorship of the SKI/STUDSVIK of Sweden. The information in this report has been provided to the USNRC under the terms of an information exchange agreement between the United States and Sweden (Technical Exchange and Cooperation Arrangement Between the United States Nuclear Regulatory Commission and the Swedish Nuclear Power Inspectorate and Studsvik Energiteknik AB of Sweden in the field of reactor safety research and development, February 1985). Sweden has consented to the publication of this report as a USNRC document in order that it may receive the widest possible circulation among the reactor safety community. Neither the United States Government nor Sweden or any agency thereof, or any of their employees, makes any warranty, expressed or implied, or assumes any legal liability of responsibility for any third party's use, or the results of such use, or any information, apparatus, product or process disclosed in this report, or represents that its use by such third party would not infringe privately owned rights.

BEST COPY AVAILABLE

STUDSVIK ENERGITEKNIK AB

1985-10-22

SKI Project 85026, 13.3-917/84

John Eriksson

Swedish Nuclear Power Inspectorate

ICAP
Assessment of RELAP5/MOD2, Cycle 36, Against FIX-II Split Break Experiment No 3027

ABSTRACT

The FIX-II split break experiment No. 3027 has been analyzed using the RELAP5/Mod2 code. The code version used, Cycle 36, is a frozen version of the code.

Four different prediction calculations were carried out to study the sensitivity on various parameters to changes of break discharge, initial coolant mass, and passive heat structures. The differences between the calculations and the experiment have been quantified over intervals in real time for a number of variables available from the measurements during the experiment.

The core inventory expressed by the differential pressure over the core was generally underpredicted. Dryout times were generally overpredicted, probably due to differences in the used dryout correlation.

Approved by- Eva Wallbrandt

BEST COPY AVAILABLE

BLANK PAGE

LIST OF CONTENTS

		Page
1.	INTRODUCTION	1
2.	FACILITY AND TEST DESCRIPTION	3
2.1	Test facility	3
2.2	The experiment	5
2.3	Measurement uncertainty	7
3.	CODE AND MODEL DESCRIPTION	9
3.1	The code features	9
3.2	The calculation input model	10
4.	THE BASE CASE CALCULATION	12
4.1	Base case calculation results	12
5.	SENSITIVITY RESULTS AND DISCUSSION	17
6.	RUN STATISTICS	20
7.	CONCLUSIONS	21
	REFERENCES	23
	FIGURES	24
	TABLES	31

APPENDICES

A. Input listings
B. Data comparison plots
C. Calculation to experiment data uncertainties

BEST COPY AVAILABLE

1. INTRODUCTION

There is a growing interest in modifying existing rules for reactor licensing and safety thermal-hydraulic calculation away from those stated in Appendix K (1) towards procedures based on best estimate types of calculations. Although Appendix K furnishes a set of skillfully and simply phrased rules, its present and inherent conservatism on safety has been partly regarded as in growing contradiction to the increasing knowledge gained from experimental programs. The many advanced best estimate thermal-hydraulic reactor codes in existence today demonstrate this.

When the simply formulated older calculation rules were replaced by best estimate type calculation procedures another measure of reliability had to be found to replace the earlier conservatism. To intentionally fulfill that aspect of a code the natural course will be an assurance of a reasonable reliability of the predicted data. Plans for conducting code assessments for the purpose of determining the accuracy and the validity of advanced LWR system codes were proposed some years ago (2). Today the International Code Assessment Program (ICAP) is in progress, under the auspices of the USNRC (3).

The calculations presented in this report is a Swedish contribution to the ICAP. The contribution is funded by the Swedish Nuclear Power Inspectorate.

In the present study the frozen version of RELAP5/MOD2 is assessed against LOCA experiment No. 3027, carried out the FIX-II test facility at Studsvik. The experiment is one of a test series, see Table 1, conducted in 1984. This test was conducted to check the reproducibility of Test 3025, which had been

BEST COPY AVAILABLE

used as a "double-blind" international standard problem (ISP-15).

A description of the test facility and this particular test is provided in Chapter 2. A description of the input model is given in Chapter 3. The base case and sensitivity calculations are discussed in Chapters 4 and 5. Run statistics are given in Chapter 6. General conclusions are drawn in Chapter 7.

Appendix A contains the complete input lists. The data comparison plots are inclided in Appendix B. Finally, results of the statistical analyses of differences between experiment and predictions for discrete time intervals are included in Appendix C.

BEST COPY AVAILABLE

2. FACILITY AND TEST DESCRIPTION

The FIX-II integral test facility was completed at the end of 1981. It is run by Studsvik Energiteknik AB under contract to the Swedish Nuclear Power Inspectorate. The experimental program comprises investigations of the fuel-to-coolant heat transfer. Various blow-down and pump trip situations conceivable in Swedish BWR's are simulated.

2.1 Test facility

The test facility itself, which is assumed to be stripped from gear not involved in the present experiment, is shown in Figure 1. The volume scaling is 1:777 of the Oskarshamn-II reactor, which is of the ASEA-ATOM external recirculation pump design. An exhaustive description of the FIX-II test facility may be obtained from Ref 4, which also provides additional references where various problems pertaining to the construction period are discussed. Therefore, only some fundamental aspects of the facility will be presented here.

The core model involves a full length rod bundle, which in the geometry is closely related to a fuel element of the ASEA-ATOM design and electrically heated by DC. Here, however, there are only 6 x 6 rod simulators instead of the 8 x 8 rods in a fuel element. Figures 2 and 3a show details from the core simulator design. As seen, filler bodies are placed between the square-section fuel channel and the circular-section pressure vessel to reduce the water-filled volume, which otherwise may influence the test by the leakage of steam to the upper plenum. The water surrounding the fillers is externally recirculated and cooled by 200 to 250 kW.

BEST COPY AVAILABLE

The upper part of the pressure vessel, Figure 3b, holds the steam separator and the steam condenser volume with its three sprinklers. During steady state power operation the steam outlet is closed. The turbine power is modelled by the partial circulation of water from the downcomer through an external 6 MW cooler with feedback to the sprinklers of the steam condenser and into the upper part of the downcomer. The flow rate in the two branches with cooled water is adjusted to control the pressure and the inlet subcooling. The remaining downcomer flow, representing the recirculation coolant flow in the reference reactor, splits at the lower downcomer end into two loops. One loop represents three of the intact recirculation lines of the reference reactor, while the other loop, representing a fourth recirculation line, incorporates the break devices. Both loops have a recirculation pump. The intact loop pump speed is regulated according to a predetermined speed history.

The FIX-II has, as part of the core model, an external bypass simulator through which about 12 % of the recirculation mass flow branches out through a regulation valve. This bypass is heated separately to represent the channel wall heat transfer. At the lower end of the bypass, Figure 3c, there is a stagnant water volume to simulate the reference reactor area for the control rod guide tubes.

Since the FIX-II facility has been designed for blowdown experiments only, no emergency core cooling equipment is installed.

BEST COPY AVAILABLE

The data collection system is constructed around a signal processor controlling 192 measurement channels. The selection of measurements is made in a signal exchange terminal. A multipurpose minicomputer transfers the raw-data of measured parameters to a magnetic tape. From this tape, the final analysis at the central computer gives the desired tables and plots from an experiment. The data acquisition system includes measurements to obtain:

- pressures (PT)
- differential pressures (dPT)
- temperatures of fluids (TE)
- mass flow (dPf, PT, TE)
- electric currents (I) and voltages (U)
- pump speeds (nT)
- water level positions (CE)
- valve positions

at places shown in the instrumentation diagram, Figure 4.

For recording clad temperatures there were about 100 thermocouples engaged at 16 axial levels of the heated length in the 36-rod bundle.

2.2 The experiment

The preparation of the experiment is initiated several hours before the actual experiment. For the heat-up of the facility, a 200 kW preheater is involved for a period lasting about 5 h. The recirculation pumps are running during this period too. Initial conditions are then established by switching the power supplies to the bundle and

BEST COPY AVAILABLE

the bypass with the 6 MW cooler and the condenser spray in operation. The preheater is now disconnected. For about 10 to 30 minutes, the electric power to the rod bundle and the bypass heating is gradually increased until the initial test conditions are reached. Necessary calibrations are made, and once the equilibrium conditions are finally approved, the sequency control equipment is activated for break opening, valve manoeuvres, power reduction, pump speed changes and so forth, according to a programmed scheme for the test. For the split break test No. 3027, the transient ends 85 s after opening of the break.

In the present FIX-II experiment, the speed of the pump on the intact recirculation line decreased from the break time to about 20 % of the initial speed at end of the transient. The speed of the broken recirculation line pump was not adjusted.

The break flow escaping through the fast opening break valve, Figure 1, is discharged into the receiving tank, T2. Initially, the tank is partly filled with cold water for efficient pool condensation of the break flow.

The split break assembly consists of a T-piece on the line from pump P2 to the lower plenum. A break flow limiting orifice, downstream of the break isolation valve, consists of an exchangeable conical inlet part followed by a restriction pipe. In experiment No. 3027, the restriction pipe and flange diameter was 12 mm corresponding to a 31 % area of one recirculation line.

BEST COPY AVAILABLE

Apart from the heat removal from the filler body space, see Chapter 2.1, some 100 kW are also lost by the non-perfect insulation encapsulating the recirculation lines and the pressure vessel. The magnitude of the steady state heat losses was one argument for not performing experiments with very small break areas at FIX-II. For BWR plants, the break size used is more interesting than small leakages.

The main measured parameters for the steady state before break are reproduced from Ref 3 in Table 4. The test performance chronology, related to the programming of the sequence control equipment, is given in Table 5.

Experimental raw data were collected for the whole period of the transient. However, internal flows were then only evaluated until about 30 s due to uncertainties expected with the two-phase flow rate measurements.

A summary of the main results (including event times, maximum cladding temperatures and some peak mass flows) is given in Table 6, see also Ref 5.

2.3 Measurement uncertainty

To obtain estimates for the accuracy of the measured data, test procedures were adapted within the experimental program. Probable errors and errors corresponding to a 95 % confidence level as derived from these tests are summarized in Table 2a. The probable errors of derived quantities, foremost mass flows, are given in Table 2b. The pump speeds are measured and controlled using a

BEST COPY AVAILABLE

tachometer of a 1 r/s accuracy. The pump characteristics, on the other hand, were verified against the manufacturer's data for cold water single phase operation, however, no tests of an in-loop hot water performance were conducted (private comm L Nilsson).

BEST COPY AVAILABLE

3. CODE AND MODEL DESCRIPTIONS

The assessment calculation for the FIX-II experiment No. 3027 was done using the RELAP5/Mod 2, Cycle 36, code received at the beginning of February 1985. The descriptive document available for this code at the time of preparing the calculation input was the rather detailed code manual (7) also explicitly containing an input data requirements manual. The code features are discussed in Chapter 3.1.

Due to the close relation to the RELAP5/Mod1 code, which has been extensively used at STUDSVIK, an existing input for the FIX-II test No. 3025 (6, 8), the previous ISP-15 exercise, formed the basis for the present RELAP5/Mod2 input. Details of the input are discussed in Chapter 3.2. Here the steady state calculation is assumed to be part of the input preparation.

3.1 The Code Features

An extensive code description for the RELAP5/Mod2 is given in the Ref 7. The main characteristics of the code are summarized in Table 3.

Since the RELAP5/Mod2 code is primarily developed for pressure reactor application, the question arises whether some important features are missing from the code for a BWR-type application like the present FIX-II experiment. A key peculiarity in this respect, is the absence in the FIX-II facility of a core top spray cooling due to the fact that facility is designed for experiments until end of blow-down only. The steady state cooling, however, is accomplished by a cold water injection at the top of an

BEST COPY AVAILABLE

internal condenser space above the core and the steam separator. The condenser space is voluminous; it results in about three quarters of the total system space being above the core top level. Thus, it is assumed that the condenser spray vaporizes without impact on the core behaviour during normal operation. Deficient sophistication in modelling droplet flows in RELAP5/Mod2 should, therefore, be far less important when predicting the present experiment than in the case of an experiment also including core cooling by refill and core top spray.

3.2 The calculation Input Model

The model geometry used in the present calculations is closely related to geometries used in several previous calculations for FIX-II experiments using previous RELAP5/Mod1 code versions (6 and 8). The nodalization diagram for the geometric modelling used is shown in Figure 5. Figures 6 and 7 account for the modelling in the geometry of the test facility.

To reproduce fundamental measured steady state quantities, see Table 4, the input for the steady state search run was modified by some additional components and regulating control systems:

I To obtain the steady state dome pressure, a time dependent volume outside of the opened steam relief valve was added. This volume had the experimentally measured dome pressure rather than the atmospheric outside pressure later during the transient.

II The speed of the pumps P1 and P2 was regulated using the RELAP5 control system to fulfill the measured mass flows.

BEST COPY AVAILABLE

III To branch off the correct mass flow into the core bypass, the junction from the lower plenum was modelled as a motor valve. By trip logic, the opening of that valve was regulated to give the experimental bypass mass flow. When entering into the transient calculation, the valve setting was logically latched.

IV The measured steam separator collapsed level was satisfied by connecting an auxiliary time dependent volume to the top of the steam separator. The connecting junction was modelled to regulate the collapsed level by water phase flow rate, depending on the level height error.

V The calculation was performed using the RELAP5/Mod2 steady-state option.

Evidently, some non-zero flows (points I and IV) will remain in the junctions from the pressure- and level regulating time dependent volumes. These flows are quite small and are influenced by the system heat balance.

The input for the steady state calculation is given in the Appendix A.

BEST COPY AVAILABLE

4. THE BASE CASE CALCULATION

The transient calculation of the base case (called Case A) was based on the restart-plot file obtained from the previously discussed steady state calculation. The additional components and regulators discussed in Chapter 3.2 were deleted, see the transient restart input in Appendix A.10. The calculation was performed under the transient calculation option. In addition, when verifying the quality of the steady state, the opening of the break was delayed.

The calculation of the transient itself was carried out without any particular problems. The smooth lapse of the CPU-time, Plot B.34 and of the computation mass error, Plot B.35, again indicate this.

4.1 Base case calculation results

A set of results from the base case calculation and the sensitivity calculations were selected to fulfil the requirement on assessment parameters given in Table 3 of Ref 3. Those parameters plotted are listed in the Table 8 and the corresponding plots reproduced in Appendix B. Since some of the parameters are not available from the experimental measurements, only the comparisons between the different calculations are shown in the plots, compare Table 8. As regards the mass flow comparisons, it must again be pointed out that the experimental data are not reliable after voiding has begun which for most measurement positions occurs about 20 s after the break time.

BEST COPY AVAILABLE

The system boundary conditions concerning the total mass inventory are the shutting of the spray flow and the feed water valves, which take place very soon after the break occurs. There is a good correlation between calculation and experiment in the mass flow rate through the steam relief valve, plot B.27. However, the break mass flow which in the experiment is measured by the increasing content of a flow receiving tank, plot B.30, has been obviously underestimated in the base case calculation. Plot B.29, where the experimental curve is derived from the receiving tank content, shows the same break flow underestimation from the calculation, particularly up to 30 s. Plot B.29 shows a pronounced peak in the measured mass flow during the very first seconds after the break on account of steam accumulating in the tubes leading from the break to the condenser receiving tank, where previously only water was present. This results in a measured superimposed volume equivalent to a water mass of about 20 kg from about 3 s from the end of the test. At the end of the test, the break valve is closed causing the receiving tank mass content to reduce with the superimposed steam volume, see Plot B.30. In the light of this correction to the total experimental break loss, the base case calculation underestimated the break loss by about 30 kg until end of the test. The calculated mass inventory in the system, Plot B.26, obviously has the opposite time elapse to that of the integrated break loss.

The thermal-hydraulic conditions in the system are also partly controlled by heat exchange with the core and other boundary structures. Plot B.3 shows the calculated heat exchange with all the

BEST COPY AVAILABLE

passive wall structures in the loop except for the separate filler body space with a known cooling power of about 260 kW in steady state operation. As Plot B.3 shows, the heat returning from the passives does exceed the decay core heating from about 30 s on. Thereby, the structure wall thickness was generally selected at 0.09 times the tube inner diameter, also compensating for flanges and other extras.

System pressures, Plots B.20, B.21 and B.33 were well predicted over the whole transient for the base case. The cycling of the steam relief valve, compare Plot B.27, dominates the behaviour of the system pressure.

From the experiment, evaluated in-loop main recirculation flows are available at the bypass inlet, at the pressure sides of the two main pumps and also at the broken loop between break and vessel inlet, see Plots B.22, B.23, B.24 and B.25. Two additional measurements valid for in-loop mass flows are the differential pressures over the orifice in the steam separator, Plot B.17, and over the core inlet restriction, Plot B.2. As mentioned before, the mass flows evaluated from the experiment, i.e. plots B.22 through B.25, are not reliable after the formation of steam has started. On the plots, the time for initiating steam formation is clearly seen to range between 20 and 25 s as enhancing flow oscillations. Up to that time, the predicted base case flow rates essentially compare well with the measurements. The most conspicuous differences are that the mass flows at the broken loop pump and at the broken loop vessel inlet, plots B.24 and B.25, are underestimated in their magnitude thus showing an underestimation in the break flow.

BEST COPY AVAILABLE

Plots B.1, B.13 and B.28 show calculated fluid densities at the core bottom, at the reactor vessel bottom and upstream of the break. Fluid densities were not directly measured in the experiment.

Several fluid temperature measurements were carried out in the experiment. At the break, plot B.31, there is a good agreement between the base case calculation and the experiment, similarly also after about 15 s at the downcomer bottom, Plot B.19. The difference in the calculated and the experimental fluid temperatures at the downcomer bottom before 15 s is due to the amount of void. In the experiment, the measured two-phase level did not reach the downcomer bottom until about 13 s (5), see also Plot B.14. The temperatures at the core inlet, Plot B.10, at the core outlet, Plot B.11, and in the upper plenum, Plot B.18, all show underestimations in the calculation after some 50 s, although the system pressure compares well with the experiment. The calculated temperature is still typically that of saturation at the high void while in the experiment, slightly superheated pure steam fills the vessel.

The fluid inventories of the core, Plot B.12, the upper plenum, Plot B.16, the downcomer, Plot B.14, and of the lower plenum, Plot B.15, are compared in the quantity of differential pressures as directly measured in the experiment. The differential pressure over the core, Plot B.12, is underpredicted during the period between 2.3 and 12 s when the steam relief valve is closed. In the calculation, the main part of this differential pressure is due to the dynamic two-phase wall friction. As the core boundary mass flows

BEST COPY AVAILABLE

compare reasonably well in the time interval, the difference in the core differential pressure is most likely caused by a strong wall friction dependance on the void fraction profile in the core. The differential pressure in the lower plenum, Plot B.15, is overpredicted in the base case after about 30 s. Comparison with Plot B.13 shows the dependance of the differential pressure on the fluid density at the bottom of the vessel.

The comparisons of the rod clad temperatures are done at the clad inner surface which is most closely equivalent to the thermocouple positions of the heated rods in the experiment. The rod calculated clad temperatures, Plots B.4 through B.9, agree reasonably well at various levels of the core with the measurements in the experiment until dryout conditions occur. Above the core midplane, levels 9, 12 and 15, the dryouts are predicted to occur definitely later than in the experiment. Actually, the calculated dryout of all levels was delayed until the void was .985 or higher. In RELAP5/Mod2 the critical heat flux is calculated according to a modified Zuber correlation using 1.-α (α is the steam void) as a factor. This should be compared with the corresponding RELAP5/ Mod1 correlation using .96-α as a factor in the critical heat flux expression, also in a modified Zuber correlation. The delay in the outset of the calculated dryouts is probably a result of the critical heat flux correlation rather than of errors in the core voids.

BEST COPY AVAILABLE

5. SNESITIVITY RESULTS AND DISCUSSION

The base case calculation (Case A) compared well with the experiment on many parameters, however, in the important heater rod temperatures after dryout, a better prediction was desired. Consequently, with the aim of lowering the core void, the break discharge coefficient, having been .85 in the base case, was assumed to be 1.0 in a first sensitivity calculation, Case B. Actually, Plots B.5 through B.8 show a better agreement in the clad temperatures at the high power levels of the model rod. At the low power levels at the bottom and at the top of the core the comparison was no better. Looking at hydraulic quantities the differential pressure over the core, Plot B.12, the system pressure, Plot B.20, and the reversed broken loop cold leg flow at the vessel inlet, Plot B.25, changed for the worse. However, the most striking evidence that the increase of the break mass flow had been constructive was the far better agreement in the mass loss, Plot B.30.

A source of uncertainty regarding the experiment is the amount of initial fluid in the facility before the break. The water volume in the experiment was accounted for by the water level in the downcomer part of the steam condenser (5). In the steady state calculation, that same level had been satisfied using a regulating system for an auxilliary flow between the loop and a time dependent volume containing saturated water. Examination of data from other FIX-II tests indicated that the initial mass of about 285 Kg, obtained by leveling off the downcomer water level according to measurement, might be a lower limit of the mass in the

BEST COPY AVAILABLE

system. Differences between the initial masses in the calculation and in the experiment arise from water in the spray, the feedwater, the cooling return lines and some additional short blind lines ending in valves which are closed in the experiment. The mass of water in those lines is estimated at about 4 kg. Another potential source of initial mass difference is the amount of liquid in droplet form in the steam condenser. Since the volume of the condenser is about .6 m^3, an actual void fraction of ~ .90 in the experiment instead of ~ .96 in the calculation means a mass difference of about 26 kg. Actually, the calculated droplet - water falling velocity of 1.2 M/s in the steady state is too high. According to the spray nozzle manufacturers specification, the spray mean droplet diameter at the actual water flow should be about .9 mm or some 1.0 mm after steam condensation. With this droplet size, the droplet falling velocity is only about .8 m/s relative to the upward velocity of steam of .2 m/s. The conclusion must be drawn that the calculation greatly underestimates the condenser water mass estimates. In a second sensitivity calculation, Case C, again with a discharge coefficient of 1.0, the calculating was done using an initial mass of 315 kg instead of 285 kg. Plot B.30 now shows a good agreement between the predicted break mass loss and the final experimental mass accumulated in the break receiver after closing the break. Fluid temperatures, Plots B.10, B.11, B.18, B.19 and B.31, which had worsened by the sole increase in the discharge coefficient in Case B, again agreed with the experiment in the Case C run. As a consequence, the same statement also applies to the system pressures, Plots B.20, B.21 and B.33.

BEST COPY AVAILABLE

On the other hand, the pressure drops in the downcomer and in the lower plenum, Plots B.14 and B.15, do indicate same overestimatation in the system fluid mass. The prediction of the heated rod clad temperatures remained the same as in the base case and the Case B calculation.

The amount heat returning from the passive structures, Plot B.3, is essential during the later part of the transient. Though the structure wall thicknesses were chosen by a simple rule of thumb, the structure modelling is believed to be reasonably reliable. To quantify the effect of the structure heat exchange on the system, a calculation, case D, was performed using the larger discharge coefficient and the larger initial mass but removing all passives. Fluid temperatures such as at the core inlet, Plot B.10, naturally decreased more rapidly towards the end of the transient. An interesting discovery is the close simliarity in the system pressure between calculation Case B and Case D. This similarity may be explained in terms of the system that is, if it is due to the heat structures or if it is due to an amount coolant that has been added itself. From about 30 s until the end of the transient, the heat returning from the structures was about 12 MWs, see Plot B.3. In the Case B calculation, Plot B.26 shows a decrease at the same time, of the calculated mass content from 110.5 to 35.2 kg. In case D, the decrease is from 132.5 to 50.75 kg. Reading the system pressures of 4.7 MPa at 30 s and 1.9 MPa at 75 s from Plot B.20 and using approximate changes in the enthalpy obtained from the water data, Case B shows about 11 MWs less enthalpy increase than Case D due to differences in mass content. This is close to the 12 MWs missing with the heat structures absent in the Case D calculation.

BEST COPY AVAILABLE

6. RUN STATISTICS

The transient calculation model used with the base case RELAP5/Mod2 prediction for the FIX-II test No. 3027 was modelled by:

58	volumes
60	junctions
70	heat structures

The volumes number includes two pump components and five time dependent volumes and among the junctions there are two valve components and four time dependent junctions.

The computer efficiency is summarized in Table 7 from the Major Edit print outs, see also Plot B.34. The table also gives the number of time step reductions from requested time steps forced by the current transport limit in the interval from the previous Major Edit. Actually the requested maximum time steps, as input values, were set high, thereby forcing the code to establish its own time steps.

The transient calculation needs were:

computer time	CPU = 828.3-118.1=710.2 s
number of time steps	DT = 972-200=782
number of volumes	C = 58
transient real time	RT = 75. s

from which also a code efficiency factor of

$$\frac{CPU \times 10^3}{C \times DT} = 15.7$$

is obtained, compare Ref 3. The computer used was a Cyber 180-835.

BEST COPY AVAILABLE

7. CONCLUSIONS

The calculation for the FIX-II No. 3027 split break and a calculation for the LOBI ISP-18 test carried out at the same time, were the first assessments done at Studsvik using the RELAP5/Mod2 code. As a lot of experience on preceeding RELAP codes had already been gained there were no particular problems in getting along with the RELAP5/Mod2. The difficulty with problems in a calculation like this, lies in making sure that the specifications for the two thousand lines of input are as correct as possible.

Although the results may seem to be credable from the calculations, there are some parameters which do cast doubt on the prediction quality. A key parameter among these being the pressure difference over the core which was underestimated. This example also emphasizes the problem of reading the information of coolant mass distribution in the experiment. In the experiment there were no in-system void measurements and the orifice mass flow measurements were also unreliable after flashing had begun. The cause of the lack of agreement in the core head therefore remains undetermined.

Important differences between experimental and calculated dryout times at various elevations were noted. This could have beed caused by inability to predict the core inventory or by an inadequate dryout correlation. It is noted that dryout was calculated only for very high void fractions. It might therefore be suspected that the discrepancies are mainly caused by the dryout correlation.

In the present calculation, the RELAP5/Mod2 code was not faced with a core top spray. However,

BEST COPY AVAILABLE

the condenser in-loop spray cooling caused trouble because the code is only capable of describing the condenser hydraulics by using the vertical slug flow regime available. Because of this the water content in the condenser was underestimated by a factor of about two.

BEST COPY AVAILABLE

REFERENCES

1. Acceptance Criteria for Emergency Core Cooling Systems for Light-Water Cooled Nuclear Power Reactors, 10 CFR, Part 50 (Appendix K), Fed Regist, 39(3). (January 1974).

2. FABIC S and ANDERSEN P S
Plans for Assessment of Best Estimate LWR System Codes.
U.S. Nuclear Regulatory Commission NUREG-0676.

3. ODAR, F and BESSETTE D E
Guidelines and Procedures for the International Thermal-Hydraulic Code Assessment and Applications Program (Draft).
U.S. Nuclear Regulatory Commission, 1985.

4. NILSSON, L and GUSTAFSSON, P-Å
FIX-II LOCA Blowdown and Pump Trip Heat Transfer Experiments, Summary report for phase 2: Description of experimental equipment.
STUDSVIK/NR-83/238, Parts 1, 2 and 3.

5. NILSSON, L et al
FIX-II - LOCA Blowdown and Pump Trip Heat Transfer Experiments. Experimental results from LOCA test No. 3027.
STUDSVIK/NR-84/485.

6. ROSDAHL, Ö and TANGEN, K
Numerical simulation of the FIX-II test 3025 (ISP-15) split-break LOCA using RELAP5/MOD 1. Post-test analysis
STUDSVIK/NR-83/330.

7. RANSOM, V H and WAGNER, R J
RELAP5/MOD 2 Code Manual
Volume 1: Code Structure Systems Models and Solution Methods.
Volume 2: Users Guide and Input Requirements.
EGG-SAAM-6377, EG & G Idaho, Inc.
April 1984.

8. ERIKSSON, J
Analysis of the FIX-II Split-Break Experiment (No 3031) using the RELAP5 code.
STUDSVIK/NR-84/396.

BEST COPY AVAILABLE

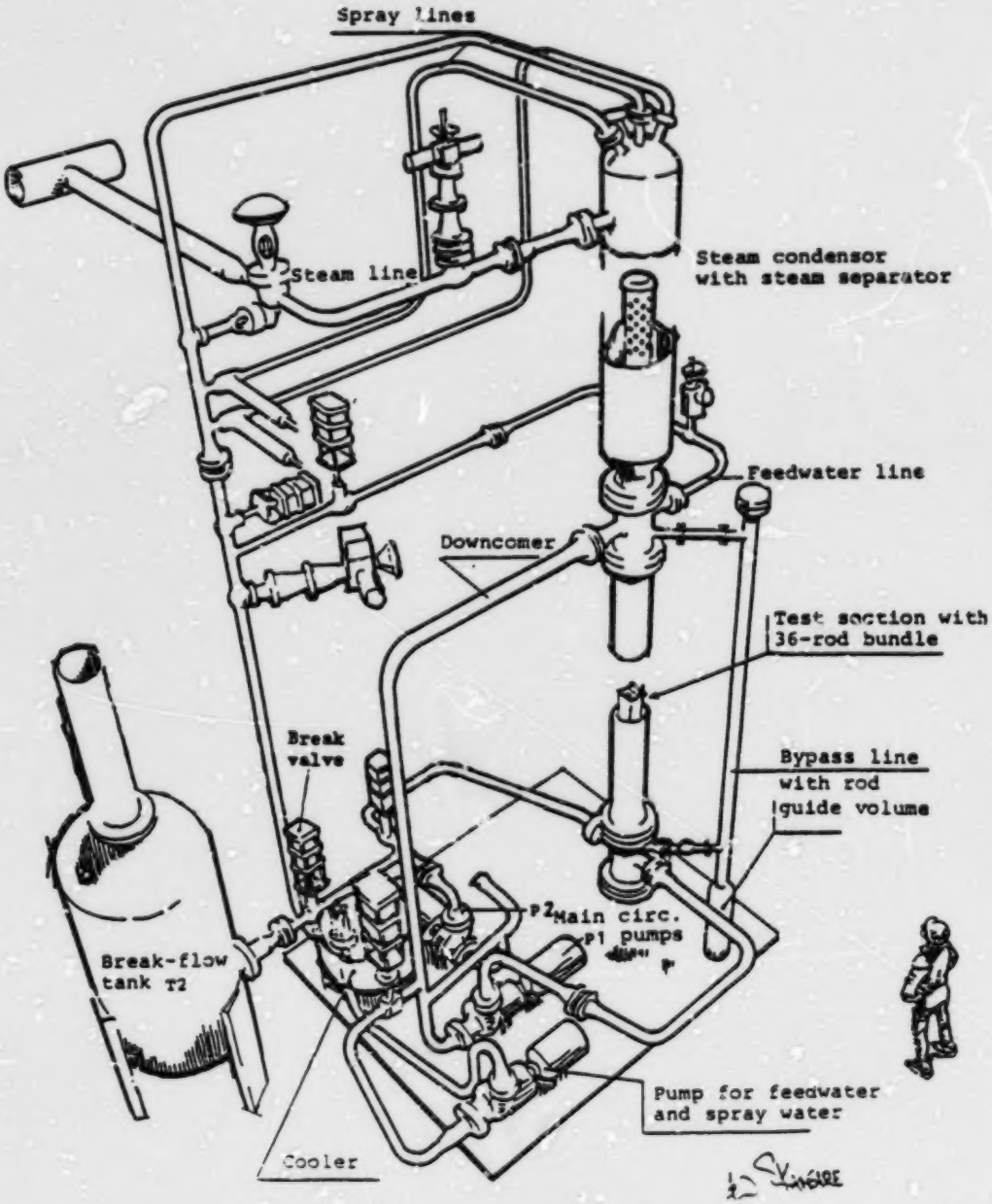


Figure 1

View of the FIX-II facility, condition for split break experiments.

BEST COPY AVAILABLE

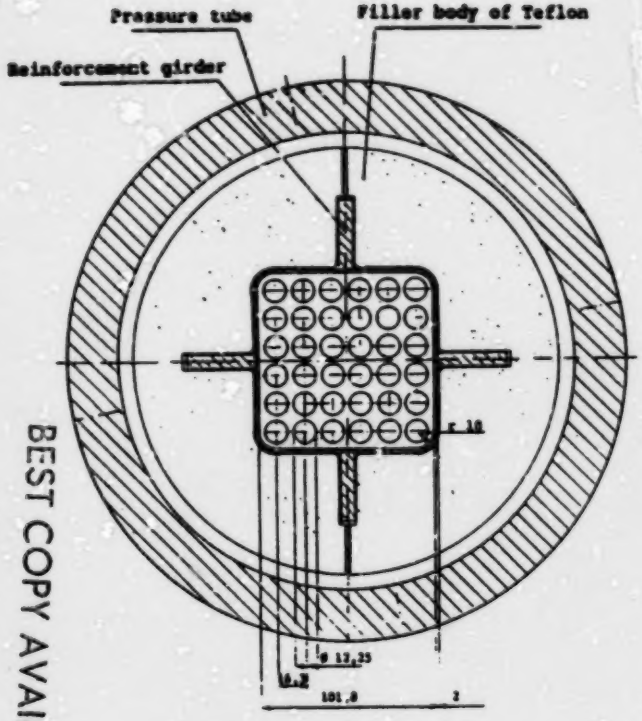


Figure 2.A

Cross section of pressure vessel and rod bundle

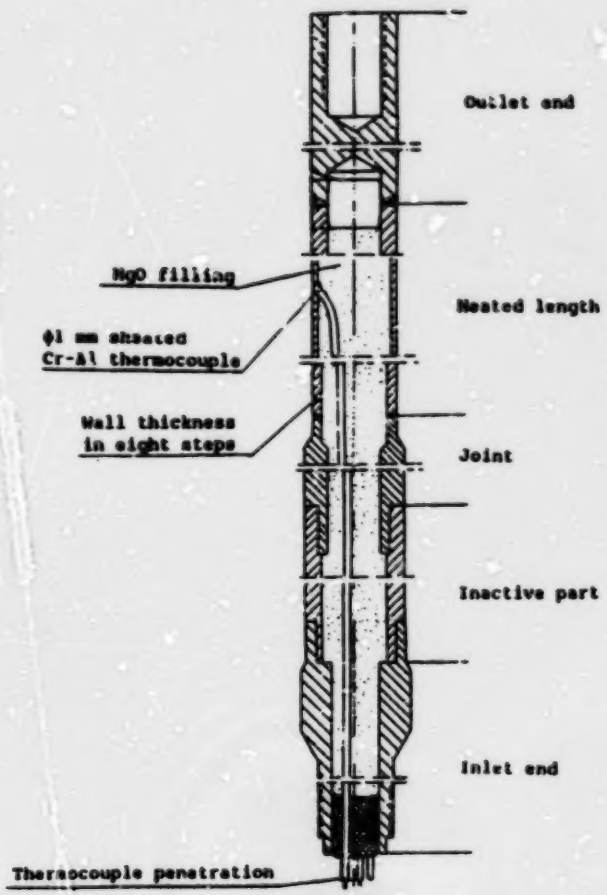
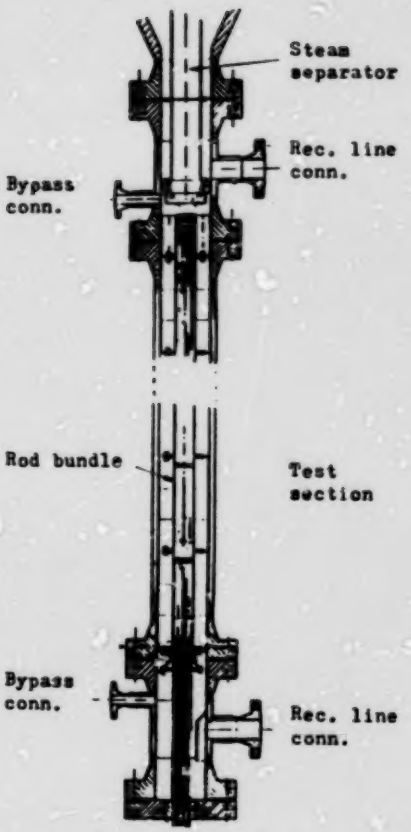


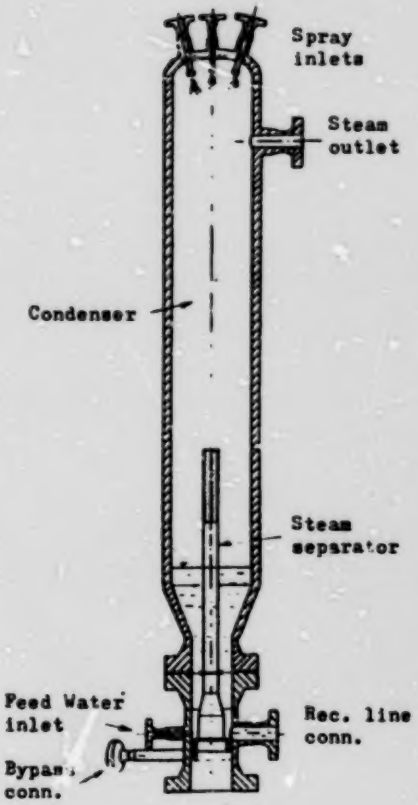
Figure 2.B

Design of a fuel rod simulator

BEST COPY AVAILABLE

BEST COPY AVAILABLE





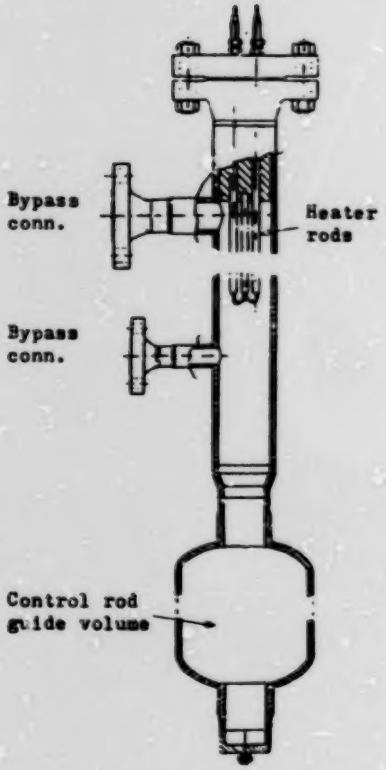


Figure 3.A

Lower plenum and core region

Figure 3.B

Steam separator and steam condenser

Figure 3.C

The external core bypass

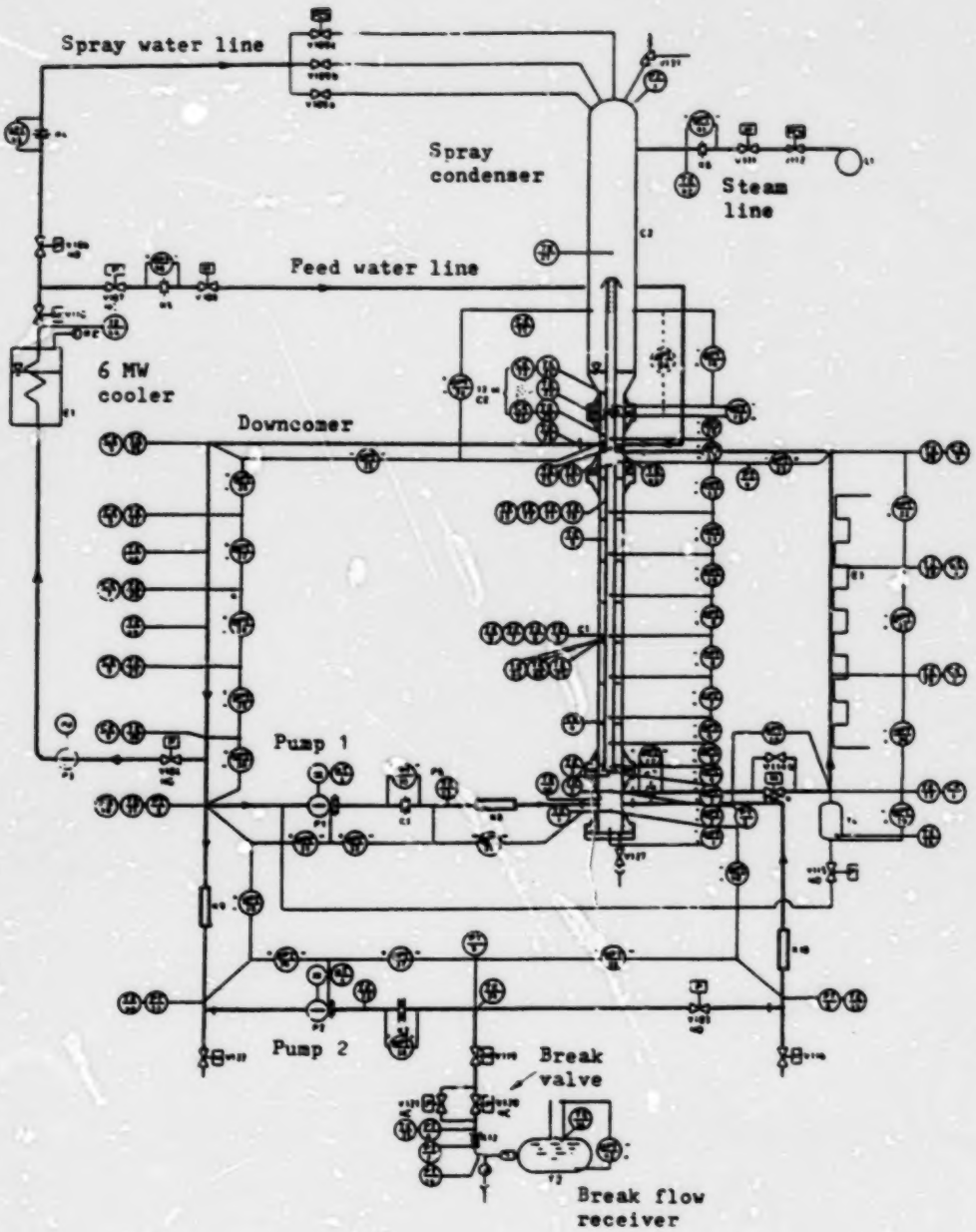


Figure 4

Instrumentation diagram for FIX-II

BEST COPY AVAILABLE

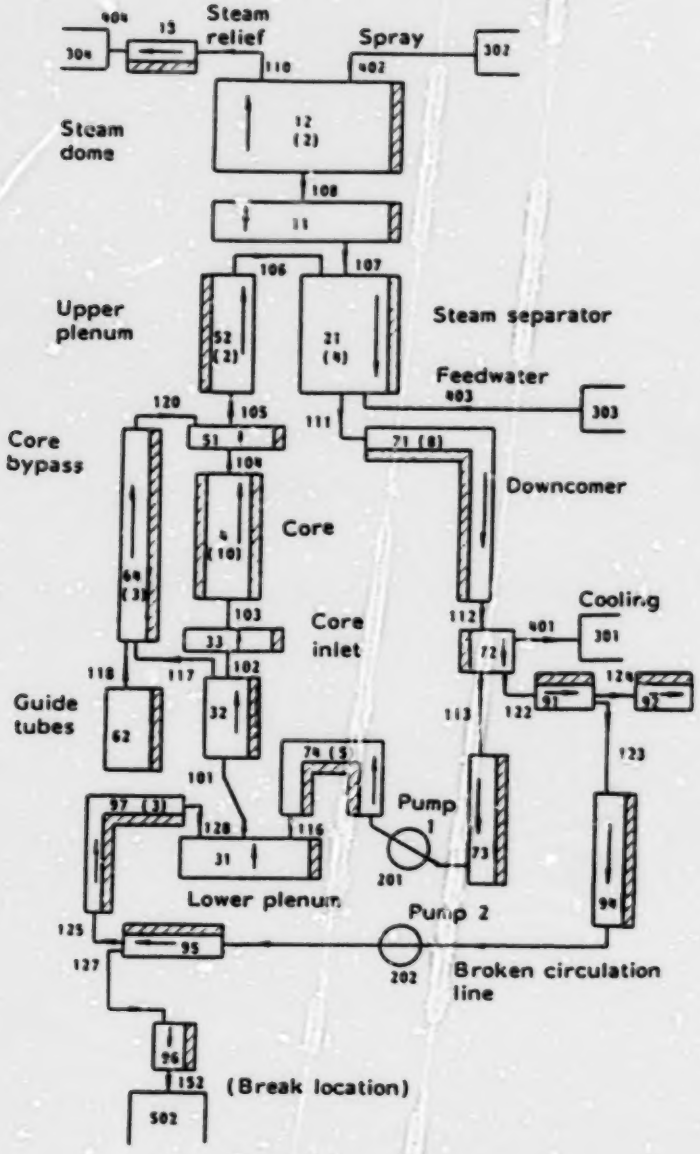
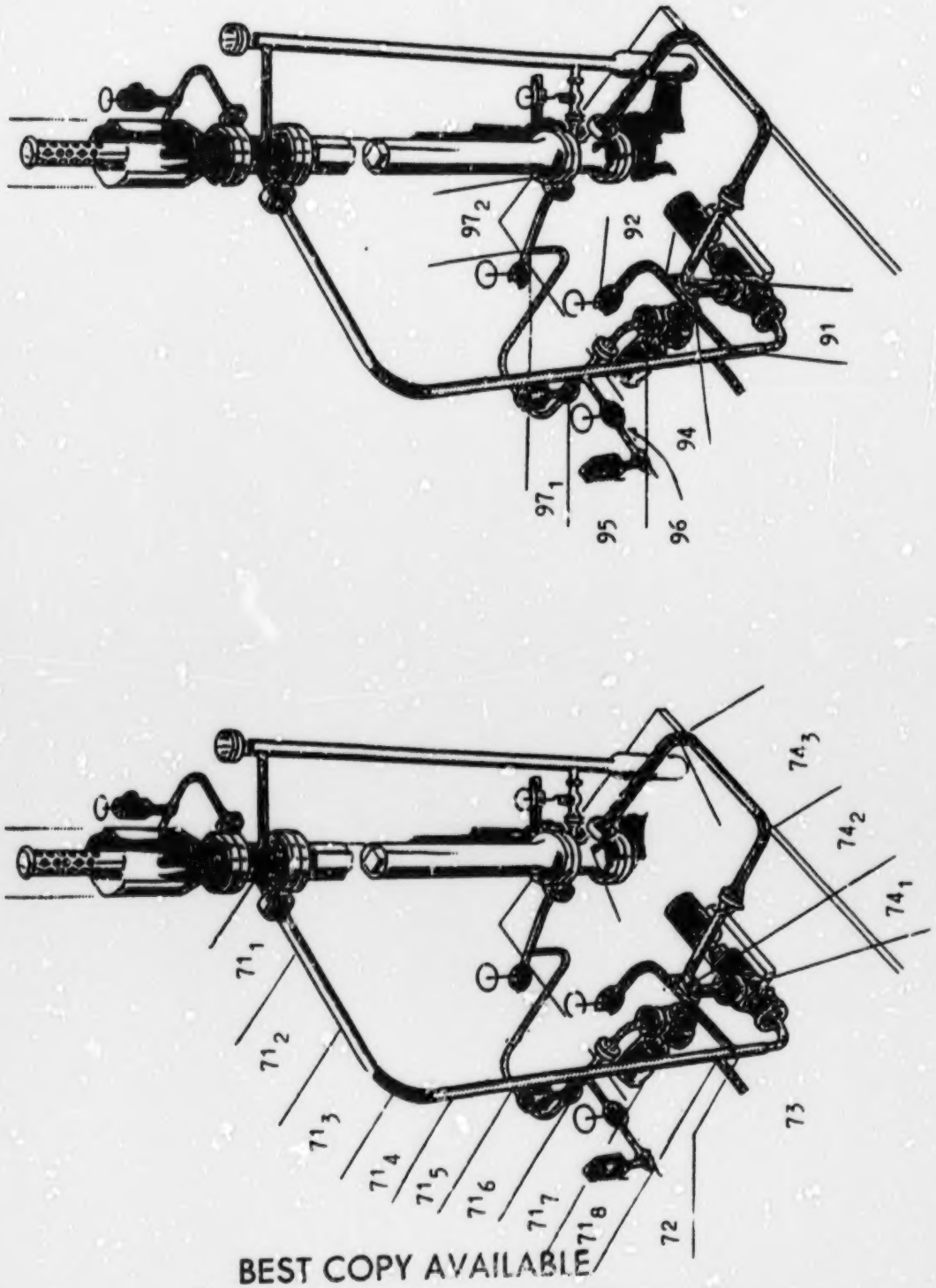


Figure 5

The nodalization diagram for FIX-II

BEST COPY AVAILABLE



BEST COPY AVAILABLE

Figure 6

Nodalization of the recirculation lines

BEST COPY AVAILABLE

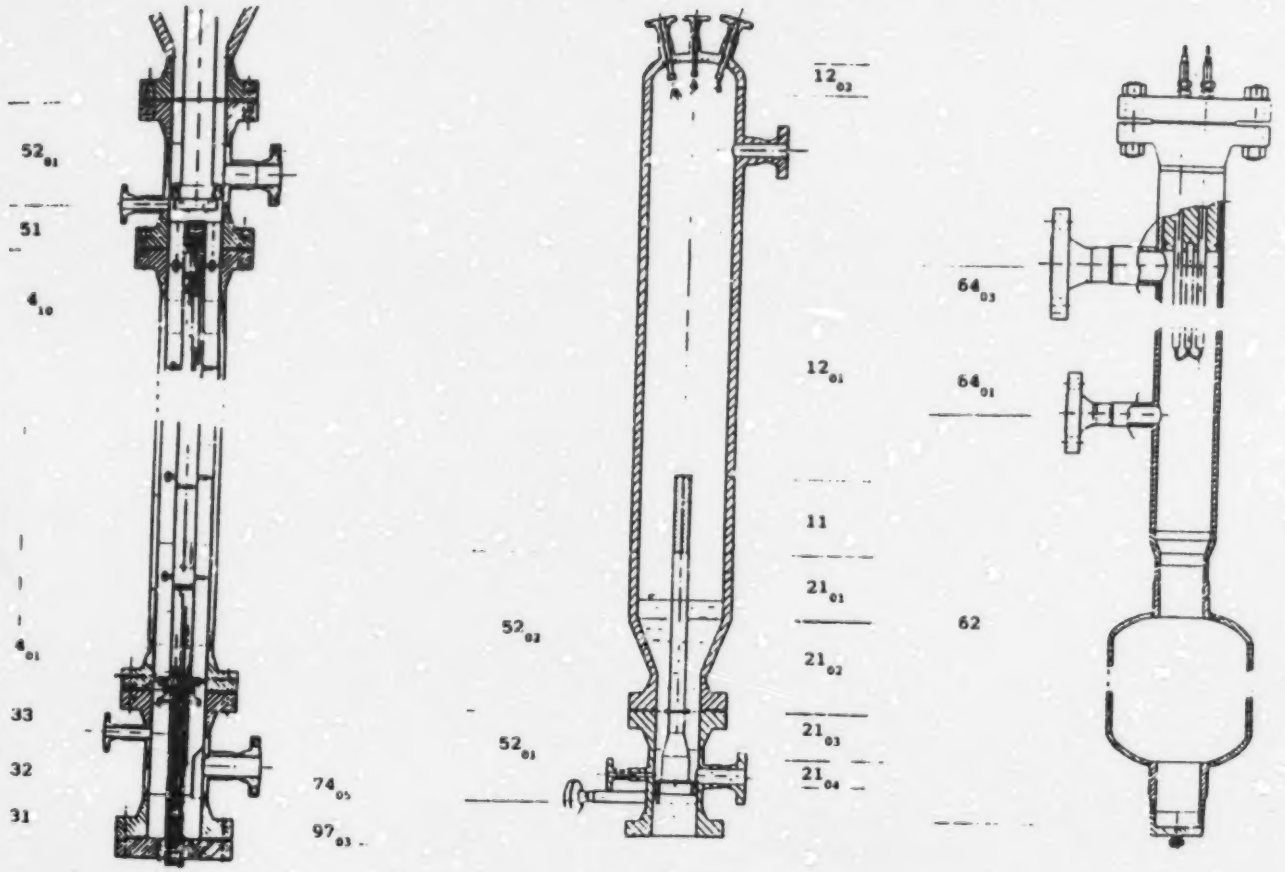


Figure 7

Nodalization of the main volumes of the FIX-II (compare Figure 3).

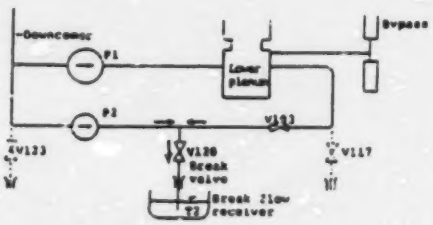
Table 1

The test matrix for the first FIX-II LOCA experimental period. Test No. 3027 is one matrix No. 2 experiment.

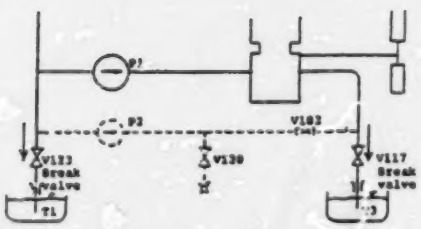
Test matrix No.		1	2	3	4	5	6
Break classification		Split breaks				Guillotine breaks	
Type of simulation (see Figure 17)		A				B	C
Break I.D.	(mm)	12.0	12.0	15.0	30.5	16.0+ 21.6	21.6+ 21.6
Relative break area	(%)*	31	31	48	200	155	200
Initial bundle power - hot channel - average	(MW)	2.35	3.35	3.35	2.35	2.35	3.35

* Refers to the scaled down flow area of one main recirculation pipe in FIX-II compared with the Oskarshamn 2 reactor.

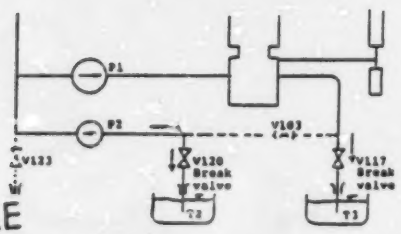
Break type A
Split break



Break type B
Simplified guillotine break



Break type C
Guillotine break



BEST COPY AVAILABLE

Table 2.A

Evaluated measurement errors

Quantity	Probable error	Error corresponding to 95 % confidence level
Pressures	0.014 MPa	0.04 MPa
Fluid temperatures	1°C	2°C
Cladding temperatures	1.6°C	3.2°C
Small range differential pressures (5 to 7.5 kPa)	0.13 kPa	0.3 kPa
Medium range differential pressures (25 to 50 kPa)	0.22 kPa	0.5 kPa
High range differential pressures (100 to 700 kPa)	0.26 kPa	0.65 kPa

Table 2.B

Errors in derived quantities

Quantity	Probable error
Mass flow rate in orifice meter K1 (P1)	0.2 kg/s
Mass flow rate in orifice meter K2 (P2)	0.14 kg/s
Mass flow rate in orifice meter K6 (steam flow)	~10 % of actual value
Mass flow rate in orifice meter K7 (Bypass)	~10 % of actual value
Break mass flow rate	~10 % of actual value
Electric power to bundle and bypass heaters	1 % of max value

BEST COPY AVAILABLE

Table 3

RELAP5/Mod 2 code features

COMPUTATION PROCESSING FEATURES

- Several problem type and execution control options as
  a. steady state initialisation using fictitious structure heat capacities for faster convergence
  b. transient calculation
  c. strip type execution, to select requested parameters from a restart file
  d. trip system, to decide on actions during calculation due to reaching specified conditions in calculation parameters.
  e. ability to delete or add hydrodynamic components, structure components and control variables at a restart of calculation.

CLASSIFICATION OF HYDRODYNAMIC MODEL

- One-dimensional, with provisions for
  a. choked flow model
  b. abrupt area change model
  c. cross flow junctions.
- Two-fluid, six equation, space-time numerical solution scheme.
- flow regime oriented field characteristics depending on mass flux and void fraction for
  a. horizontal flow with bubbly, slug, mist and stratified fields
  b. vertical flow with bubbly, slug, annular-mist (and stratified) fields
  c. high mixing flow with bubbly and mist fields (for pumps).

BEST COPY AVAILABLE

Table 3 con't

HYDRODYNAMIC COMPONENENTS (Input systematics)

- Volume type components

  a. single volume

  b. pipe and annulus, for condensed input of several similar single volumes

  c. time dependent volume, for defining a boundary source with a time dependent fluid state

  d. branch, a volume capable of two or more connecting junctions at either end

  e. pump, characterized by rated values for flow, head, torque, density and moment of inertia. The single phase homologous curve, two-phase multipliers and phase difference tables to model the dynamic pump behaviour

  f. special system components for steam separator, jetmixer, turbine and accumulator.

- Junction type components

  a. single junction

  b. time dependent junction, for a time dependent junction flow whith a time dependent or controlled flow state

  c. cross-flow junction, to model a small cross flow, a tee branch or a small leak flow

  d. valve, various operation characteristics available for check valve, trip valve, inertial valve and relief valve.

INTERFASE CONSTITUTIVE EQUATIONS

- Interphase drag

  a. steady drag due to viscous shear depending on flow regime. Semi-empirical mechanisms to describe flow regime transitions

  b. dynamic drag due to virtual mass effect.

- Interphase mass and heat transfer depending on flow regime and the fluid fields to saturation temperature differences

BEST COPY AVAILABLE

Table 3 con't

FLUID TO WALL CONSTITUTIVE EQUATIONS

- Wall friction due to wall shear effects formulated for flow regimes and based on a two-phase multiplier approach.

- Wall heat transfer depending on flow characteristics defined for

  a. single-phase forced convection (Dittus-Boelter)

  b. saturated nucleate boiling (Chen)

  c. subcooled nucleate boiling (modified Chen)

  d. critical heat flux (Biasi or modified Zuber)

  e. transition film boiling (Chen)

  f. film boiling (Bromley-Pomeranz and Dougall-Rohsenow)

  g. condensation (partly Dittus-Boelter).

- Interfacial mass transfer at the wall depending on wall, fluid and saturation temperatures for

  a. subcooled and saturated boiling

  b. transition film and film boiling

  c. condensation.

HEAT STRUCTURES

These may be rectangular, cylindrical or spherical in shape. The structure position is defined through component numbers of left and right hand side hydraulic components. A structure is physically defined by the geometry and the temperature dependent conductivity and volumetric heat capacity data. The structure model is further specified by the number of internal mesh points in the direction of heat flow.

CONTROL COMPONENTS

By these new (control) variables are defined from calculated parameters using algebra, standard functions, trip type operands or integrals.

BEST COPY AVAILABLE

BEST COPY AVAILABLE

Table 4

Initial conditions, measured for test No. 3027 and predicted (Data for test No. 3025 within parenthesis).

		Test		Prediction
Pressure in the steam dome	MPa	6.96	(7.00)	6.98
Power to the 36-rod bundle (incl connections)	MW	3.425	(3.385)	3.385
Power to the bypass heaters	kW	65.7	(57.4)	57.4
Cooling power in the filler body space	kW	264	(196)	207
Mass flow rate through pump P1	kg/s	4.85	(4.56)	475
Mass flow rate through pump P2	kg/s	1.60	(1.55)	1.49
Mass flow rate in the bypass	kg/s	78	(.71)	.61
Mass flow rate in the 36-rod bundle	kg/s	5.67	(5.40)	5.62
Mass flow rate in teh spray line	kg/s	5.10	(5.36)	5.36
Mass flow rate in the feed water line	kg/s	2.54	(2.49)	2.49
Temperature of water at the bundle inlet (TE2)	°C	267	(269)	268
Temperature of feed and spray water	°C	179	(181)	180
Water level in the spray condenser (Fig 6)	m	.791	(.815)	.825
Rotational speed of pump P1	/s	27.16	(25.46)	26.89
Rotational speed of pump P2	/s	35.57	(33.42)	35.32

BEST COPY AVAILABLE

Table 5

List of events in test No. 3027 and in prediction case A (Data for Test No. 3025 within parenthesis).

Event	Time (s) Imposed action		System reaction		Prediction
The break occurs (Valve V120 starts to open)	0	0		0	
Start of coast down of pump P1	0.0	(0.0)			0.0
Flow reversal in the samll RCL between break and LP			0.0	(0.0)	0.0
Start of power decay in rod bundle	0.0				0.0
Start of power decay in bypass heaters	0.1	(1.1)			0.0
The SRV starts to open	0.5	(0.4)			0.4
The SRV is fully open	1.0	(1.0)			1.0
The first dryout occurs (level 16 to 12, several rods)			1.2-2.2	(1.4)	not seen
The SRV starts to close	1.6	(1.6)			1.6
Minimum in steam dome pressure occurs (6.69 MPa)			1.9	(1.8)	1.8
The spray flow is closed	2.1	(1.8)			1.9
The feed water flow is closed	2.1	(1.9)			2.0
Valve V104 to the evaporation cooler is closed	2.1	(2.0)			2.0
The SRV is closed	2.5	(2.3)			2.3
Rewetting of the first dryout			3.5	(3.6)	not seen

BEST COPY AVAILABLE

Table 5 con't

Event	Imposed action		Time (s) System reaction		Prediction
Maximum in steam dome pressure (7.31 MPa)			7.4	(7.8)	8.1
The SRV starts to open	12.0	(11.8)			12.3
The SRV is fully open	12.7-78.7	(12.3-75.3)			12.8
The water (two phase) level reaches lowermost part of the downcomer			14.1	(13.9)	13.5
Cavitation in pump P2 in the broken RCL			14.7	(14.7)	15.3
Flow reversal at the bundle inlet			15.0		15.4
Flow reversal in part of the intact RCL			24.4	(21.)	22.2
Flasning starts in the LP			23-24	(22.)	21.
Level swell (recovery) in lower and middle part of the downcomer			24-30	(23-31)	26-29.4
Flashing starts in the bypass guide tubes volume			24.3	(25)	25.6
Peak in teh bypass flow into the UP			25.3	(26.7)	20.4 and 31.0
Core uncovery begins at rod level 16			45.	(49.)	63.
Core uncovery begins at rod level 7			51.	(51.)	61.
Core uncovery begins at rod level			67.	(62)	not seen
Tripping of the bundle power (stop signal of test)			70.5	(75.2)	75.

BEST COPY AVAILABLE

Table 6

Main results measured for the test No. 3027 and predicted (Data for the test 3025 within parenthesis).

Simple-value parameter		Experiment		Prediction (Case A)
Time to				
- (first) dryout	(s)	1.2	(1.4)	-
- max rod temperature	"	2.7	(3.6)	-
- rewetting, max	"	3.5	(3.6)	-
- bundle uncovery	"	45	(49)	62
- 2.0 MPa dome pressure	"	80.5	(79)	~ 78.5
- end of break discharge	"	78.5	(75.6)	75
Dome pressure				
- max after the break	(MPa)	7.31	(7.34)	7.35
- at end of break discharge	"	2.09	(2.15)	2.15
Max break mass flow				
- through break	(kg/s)	6.2	7.4	6.8
- through pump P2	"	~4.1	3.6	3.3
- from lower plenum	"	~4.5	-	3.5
Integrated mass flow				
- through break	(kg)	222	(214)	195
- through steam relief valve	"	40	(39.7)	39.8

Table 6 con't

Simple-value parameter		Experiment	Prediction (Case A)
Max rod temperature			
- during dryout	(°C)	360 (389)	-
- at end of break discharge	"	382 (352)	~303
Position of max rod temp			
- during dryout	(rod/level)	10/14 (16/14)	-
- at end of discharge	"	14/11 (22/7)	/5

BEST COPY AVAILABLE

Table 7

Run statistics data (Case A)

Transient time (s)	Computer CPU time (s)	Number of time steps	Number of reduced current	Number of reduced mass
-5	0.	0		
0	118.1	200	100*	0
10	229.1	384	90	0
20	227.6	455	19	0
30	353.9	533	7	1
40	437.1	612	6	0
50	517.6	695	13	2
60	569.3	759	11	0
70	766.8	928	1	63**
75	828.3	982	0	10

* All current limit time step reductions was caused by core flows

** Mass error limitation occuring in downcomer lower part

BEST COPY AVAILABLE

Table 8

Parameters plotted and used in the assessment comparison.

COMPONENT	CONTROL PARAMETER *	EXPERIMENT (IDENTIFIER)	PREDICTION (MINOR EDIT)	PLOT IDENTIF. EXP.	CALC.	PLOT NO.
CORE	FLUID DENSITY, BOTTOM	***	RHO 04.01		RH1?	B. 1
	MASS FLOW RATE, INLET *	DPT 4	P 33.01 - P04.01	D 4	FD4?	B. 2
	HEATING POWER	X 801	CNTRLVAR 57	X801	HP1?	B. 3
	CLAD TEMPERATURE, LEVEL 1	TE 191, TE 206, TE 211, TE 246	HTTEMP 4.0100	TC 1	HT1?	B. 4
	-"- , LEVEL 3	TE 188, TE183, TE 243, TE 248	HTTEMP 4.0300	TC 3	HT2?	B. 5
	-"- , LEVEL 5	TE 203, TE 227, TE 232, TE 237, TE 252	HTTEMP 4.0400	TC 5	HT3?	B. 6
	-"- , LEVEL 9	TE 162, TE 137, TE 167, TE 172, TE 187, TE 197, TE 272	HTTEMP 4.0600	TC 9	HT4?	B. 7
	-"- , LEVEL 12	TE 118, TE 133, TE 138, TE 148, TE 223	HTTEMP 4.0700	TC12	HT5?	B. 8
	-"- , LEVEL 15	TE 175, TE 190, TE 275	HTTEMP 4.1000	TC15	HT6?	B. 9
	INLET TEMPERATURE	TE 3	TEMPF 33.01	T 3	TF1?	B.10
	OUTLET TEMPERATURE	TE 14	TEMPF 51.01	T 14	TF2?	B.11
	CORE INVENTORY *	DPT 5 + DPT 6+ DPT 7 + DPT 8+ DPT 9 + DPT 10+ DPT 11 + DPT 12	P 04.01- P 51.01 **	D CO	FDC?	B.12
VESSEL	FLUID DENSITY, BOTTOM	***	RHO 31.01		RH2?	B.13
	DOWNCOMER MASS INVENTORY *	DPT 27 + DPT 28 + DPT 29 + DPT 30	P 71.03 - P 72.01 **	D DC	FDD?	B.14
	LOWER PLENUM MASS INVENTORY *	DP 2 + DP3 - DP 1	P 31.01 - P 32.01 **	D LP	FDL?	B.15
	UPPER PLENUM MASS INVENTORY *	DP 13 + DP 14	P 51.01 - P 52.01 **	D UP	FDU?	B.16
	PRESSURE LOSS, S.S. ORIFICE	DP 56	P 52.01 - P 53.02	D 56	FOS?	B.17
	UPPER PLENUM TEMPERATURE	TE 15	TEMPF 52.01	T 15	TF4?	B.18
	DOWNCOMER TEMPERATURE, BOTTOM	TE 31	TEMPF 71.08	T 31	TF3?	B.19
	LOWER PLENUM PRESSURE	PT 3	P 31.01	P 3	P 1?	B.20
	UPPER PLENUM PRESSURE	PT 4	P 52.01	P 4	P 2?	B.21
	MASS FLOW RATE, BYPASS	X 602	MFLOWJ 117	X602	FF1?	B.22

BEST COPY AVAILABLE

COMPONENT	CONTINUOUS PARAMETER *	EXPERIMENT (IDENTIFIER)	PREDICTION (P/WOR EDIT)	PLOT IDENTIF. EXP.	PLOT IDENTIF. CALC.	PLOT NO.
RECIRCULATION LINE	MASS FLOW RATE. I. L. PUMP (ORIFICE K1)	X 603	MFLOWJ 201.02	X603	MF2?	B.23
	MASS FLOW RATE. B. L. PUMP (ORIFICE K2)	X 604	MFLOWJ 202.02	X604	MF3?	B.24
	MASS FLOW RATE. B. L. VESSEL INLET (SPOOL PIECE K10)	X 610	MFLOWJ 97.02	X610	MF4?	B.25
SYSTEM	MASS INVENTORY	***	TMASS		MAT?	B.26
	MASS FLOW RATE. STEAM RELIEF	X 607	MFLOWJ 404	X607	MF5?	B.27
	HEAT LOSS. PASSIVES	***	CNTRLVAR 53		HL1?	B. 3
BREAK	FLUID DENSITY	***	RHO 96.01		RH3?	B.28
	MASS FLOW RATE	X 636	MFLOWJ 152	X636	MF6?	B.29
	MASS FLOW RATE. INTEGRATED	X 661	CNTRLVAR 55	X661	ML1?	B.30
	INLET TEMPERATURE	TE 34	TEMPF 96.01	T 34	TF5?	B.31
	INLET SUBCOOLING	***	TEMPG 96.01 - TEMPF 96.01		TSU?	B.32
	INLET PRESSURE	PT 6	P 96.01	P 6	P 3?	B.33
RELAP5/MOD2	COMPUTAION CPU TIME	***	CPUTIME		CPU?	B.34
	COMPUTATIONAL MASS ERROR	***	EMASS		MAE?	B.35

* THE COMPARISON PARAMETERS ARE THOSE REPORTED AS DIRECTLY MEASURED OR AS COMPUTED RESULTS FROM THE EXPERIMENT. PRESSURE DIFFERENCE INSTEAD OF MASS FLOW RATE OR OF MASS INVENTORY.

** CORRECTIONS APPLIED TO RESUME THE CORRECT PRESSURE SENSOR LEVELS.

*** NO DATA AVAILABEL FROM THE EXPERIMENT.

BEST COPY AVAILABLE

BEST COPY AVAILABLE

```
*       INPUT FOR RELAP5/mod2
*     FIX-II SPLIT BREAK STEADY-STATE (PRECALCULATION)
*   ****CHANGES BY OLC FOR 3027 SIMULATION,  MARCH 85
* 24APR85  OLC  CORE ROUGHNESS CHANGED TO 1E-4 FROM 0.0
* 24APR85  OLC  JUNC 5201 E CHANGED FROM 2.34 TO 1.70
* 24APR85  OLC  JUCH 103 KF CHANGED FROM 0.43 TO 0.34
* 24APR85  OLC  ABOVE CHANGES MADE TO GET OL OC TO AGREE WITH 3027 OP
*   ****CHANGE CARDS ADDED AT END OF DECK  ****
*     100 A/D POWER MEAN CORE CHANNEL
0000100  NEW   STDY-ST
0000101  RUN
0000105   10.      20.
0000203 24.0  1.0E-6    0.0E-2    00006     3  100   1000
*
*
0000302  P          0320100000   *PRESSURE LOWER PLENUM VOL 2
0000303  P          0040100000   *PRESSURE CORE VOL 1
0000312  P          0041100000   *PRESSURE CORE VOL 10
0000315  P          0510100000   *PRESSURE UPPER PLENUM
0000316  P          0111010000   *PRESSURE STEAM DOME VOL11
0000317  P          0120100000   *PRESSURE STEAM DOME VOL12-1
0000318  P          0210400000   *PRESSURE DC ANNULUS VOL4
0000320  CNTRLVAR   041          *LIQUID LEVEL IN DC ANNULUS
0000321  VLVAREA    0000000117   *VALVE AREA BY-PASS INLET
0000331  VOIDG       0040100000  *VOID CORE VOL 1
0000332  VOIDG       0040200000  *VOID CORE VOL 2
0000333  VOIDG       0040300000  *VOID CORE VOL 3
0000334  VOIDG       0040400000  *VOID CORE VOL 4
0000335  VOIDG       0040500000  *VOID CORE VOL 5
0000336  VOIDG       0040600000  *VOID CORE VOL 6
0000337  VOIDG       0040700000  *VOID CORE VOL 7
0000338  VOIDG       0040800000  *VOID CORE VOL 8
0000339  VOIDG       0040900000  *VOID CORE VOL 9
0000340  VP          0041000000  *VOID CORE VOL 10
0000341  VOIDG       0640300000  *VOID BY-PASS OUTLET
0000342  VOIDG       0520200000  *VOID RISER TOP
0000343  VOIDG       0111010000  *VOID STEAM DOME VOL11
0000344  VOIDG       0120100000  *VOID STEAM DOME VOL12-1
0000345  VOIDG       0120200000  *VOID STEAM DOME VOL12-2
0000346  VOIDG       0210100000  *VOID DC ANNULUS VOL1
0000347  VOIDG       0210200000  *VOID DC ANNULUS VOL2
0000348  VOIDG       0210300000  *VOID DC ANNULUS VOL3
0000349  VOIDG       0210400000  *VOID DC ANNULUS VOL 4
0000350  VOIDG     0640100000    **VOID BYPASS VOL1
0000351  VOIDG     0620100000    **VOID GUID TUBE VOL
0000352  VOIDG     0320100000    **VOID LOWER PLENUM VOL2
0000353  VOIDG     0310100000    **VOID LOWER PLENUM VOL1
0000354  VOIDG     0060100000    **VOID BREAK VOLUME
0000355  QUALS     0130100000    *QUALITY STEAM LINE
0000356  VOIDG     0730100000    *VOID PUMP P1 SUCTION LINE
0000357  VOIDG     0940100000    *VOID PUMP P2 SUCTION LINE
0000359  MFLOWJ     600000000    *MASS FLOW STEAM VALVE
0000360  MFLOWJ    1100000000    *MASS FLOW STEAM RELIEF
0000361  MFLOWJ     1030000300   *MASS FLOW CORE INLET
0000362  MFLOWJ     0030200100   *MASS FLOW CORE JUN 2
0000363  MFLOWJ     0040100400   *MASS FLOW CORE JUN 4
0000364  MFLOWJ     0040300600   *MASS FLOW CORE JUN 6
0000365  MFLOWJ     0040500800   *MASS FLOW CORE JUN 8
```

```
0000366  MFLOWJ     1040030000   *MASS FLOW CORE OUTLET
0000367  MFLOWJ     1170000000   *MASS FLOW BY-PASS INLET
0000368  MFLOWJ     1200000000   *MASS FLOW BY-PASS OUTLET
0000369  MFLOWJ     1060000000   *MASS FLOW FROM RISER
0000370  MFLOWJ     1070000000   *MASS FLOW FROM STEAM DOME VOL11
0000371  MFLOWJ     1080000000   *MASS FLOW FROM STEAM DOME VOL12-1
0000372  MFLOWJ     1120100000   *MASS FLOW FROM STEAM DOME VOL12-2
0000373  MFLOWJ     0210100000   *MASS FLOW DC ANNULUS JUN 1
0000374  MFLOWJ     0210200000   *MASS FLOW DC ANNULUS JUN 2
0000375  MFLOWJ     0210300000   *MASS FLOW DC ANNULUS JUN 3
0000376  MFLOWJ     2010200000   *MASS FLOW PUMP1 OUTLET
0000377  PUMPVEL    *40000201    *PUMP1 VELOCITY (RAD/S)
0000378  MFLOWJ    -2020200000   *MASS FLOW PUMP2 OUTLET
0000379  PUMPVEL    40000202     *PUMP2 VELOCITY (RAD/S)
0000380  CNTRLVAR 53             *STRUCTURE HEAT LOSS
0000381  CNTRLVAR 54             *STRUCTURE HEAT LOSS,INTEGRATED
0000383  CNTRLVAR 55             *INTEGRATED BREAK LOSS
0000384  CNTRLVAR 56     * 000-HEAT LOSS
0000385  CNTRLVAR 57     * COR-POWER
0000386  CNTRLVAR 58     * BY-PASS POWER
0000387  CNTRLVAR 59     * TOTAL POWER
0000389  CNTRLVAR 113    * JUNIL. HEAT LOSS
0000391  CNTRLVAR  062           *LIQUID LEVEL IN UPPER PLENUM
0000392  CNTRLVAR  063           *LIQUID LEVEL IN CORE
0000393  CNTRLVAR  064           *LIQUID LEVEL IN LOWER PLENUM
*0000394  CNTRLVAR  014          *FLOW QUAL CORE VOL5
*0000395  CNTRLVAR  015          *FLOW QUAL CORE VOL6
*0000396  CNTRLVAR  016          *FLOW QUAL CORE VOL7
*0000397  CNTRLVAR  017          *FLOW QUAL CORE VOL8
*0000398  CNTRLVAR  018          *FLOW QUAL CORE VOL9
*0000399  CNTRLVAR  019          *FLOW QUAL CORE VOL10
*
*     PUMP DUMMY TRIP
0000501  TIME      0          GT   NULL 0    0.     L *USED AT STEADY S
*     BY-PASS VALVE TRIPS
0000502  MFLOWJ    1170000000 GT   NULL 0    0.001  N *STEADY STATE
0000503  MFLOWJ    1170000000 LT   NULL 0    0.595  N *STEADY STATE
*     RUPTURE TRIPS
0000504  TIME      0          GT   NULL 0  1000.    L *STEADY STATE CAR
0000505  TIME      0          LT   NULL 0    0.    L
*
*
*************************
*
0310000   VOL31     BRANCH
0310001   0
0310101   0.    0.151     0.00703   0.   00.  0.151     0.   0.0573    00
*************************
*
0320000   VOL32     BRANCH
0320001   0
0320101   0.    0.325     0.01147   0.   00.  0.325     0.   0.0562    00
*************************
*
0330000   VOL33     SNGLVOL
0330101   0.    0.271     0.01250   0.   00.  0.271     0.   0.0573    00
*************************
*
```

```
0040000   VOL4      PIPE
0040001   10
0040101   0.0 10
0040301   0.368 10
0040401   0.0022344 10
0040601   00. 10
*0040801   0.   0.0136  10
0040901   0.05 0.05  2   0.00 0.00  3   0.05 0.05  7   0.00 0.00  8
0040902   0.05 0.05  9
0041001   00   10
0041101   1000  9
*************************
*
0510000   VOL51     BRANCH
0510001   0
0510101   0.    0.159     0.09525   0.   00.  0.159     0.   0.0017    00
*************************
*
0520000   VOL52     PIPE
0520001   2
0520101   0.0  2
0520201   0.002734   1
0520301   0.525      1   0.053    2
0520401   5.00035    1   0.007485 2
0520601   00.  2
0520001   0.   0.   2
0520901   2.54   2.54   1
0521001   00   2
0521101   0000 1
*************************
*
0110000   VOL11     ANNULUS
0110001   1
0110101   0.0  1
0110301   0.063 1
0110401   0.00070 1
0110601   00.  1
0110001   0.   0.   1
0111001   00 1
*************************
*
0120000   VOL12     PIPE
0120001   2
0120101   0.0  2
0120301   2.286      1   0.130    2
0120401   0.03200    1   0.02018  2
0120601   00.  2
0120001   0.   0.   2
0121001   00   1   01   2
0121101   1000 1
*************************
*
0130000   VOL13     SNGLVOL
0130101   0.    3.05m     0.01031   0.  00.  3.05m 0.  0.  00  *STEADY STATE CA
*************************
*
0210000   VOL21     ANNULUS
0210001   4
```

The stady state input

BEST COPY AVAILABLE

```
0210101   0.0  4
0210201   0.   1   0.035137   2    0.   3
0210301   0.486 1   0.549 2   0.256 3   0.166 4
0210401   0.07260 1      0.04700 2      0.01250 3      0.50527 4
0210601   -99. 4
0210801   0. 0.3960 1    0. 0.2092 2    0. 0.1516 3    0. 0.1117 4
0210901   0.   0.   1   0.96   0.96   2   0.   0.   3
0211001   00 4
0211101   1000 1
*********************
*
0710000   VOL71    PIPE
0710001   5
0710101   0.0  0
0710301   0.9987 3   0.0198 0
0710401   0.000146 3 0.007726 0
0710601   0. 3 -99. 0
0710801   0. 0. 0
0710901   0.00 0.00 2    0.10 0.10 3    0.00 0.00 7
0711001   00 0
0711101   1000  7
**********************
*
0720000   VOL72    BRANCH
0720001   0
0720101   0.   0.300     0.002025  0.  -90. -0.300     0.   0.        00
**********************
*
0730000   VOL73    SNGLVOL
0730101   0.   1.240     0.01129   0.  -90. -0.750     0.   0.   00
**********************
*
0740000   VOL74    PIPE
0740001   5
0740101   0.00 5
0740201   0.   1    0.001305  2    0.   4
0740301   0.553 1   1.117 2   2.876 3   1.580 4   0.215 5
0740401   0.00360 1 0.00475 2 0.01225 3 0.03023 4 0.00226 5
0740601   90. 3     0. 4    -90. 5
0740801   0. 0. 4   0. 0.0015 5
0740901   0.17 0.17 1    0.79 0.79 2    0.22 0.22 3    1.00 1.00 4
0741001   00 5
0741101   1000  1   1000  2   1000  3   1000  4
**********************
*
0620000   VOL62    SNGLVOL
0620101   0.   1.221     0.03227   0.  -90. -1.221     4   0.        00
**********************
*
0640000   VOL64    PIPE
0640001   3
0640101   0.0 3
0640301   1.467 1   1.335 2   1.108 3
0640401   0.00101 1 0.00043 2 0.01147 3
0640601   90.  3
0640801   0. 0.0090 1    0. 0.0577 2    0.   0.0529 3
0640901   0.00 0.00 2
0641001   00 3
```

```
0642101   1000 2
*
* BRANCH CIRCULATION LINE
**********************
*
0910000   VOL91    BRANCH
0910001   0
0910101   0.   1.246     0.00570   0.   0.   0.   0.   0.   00
**********************
*
0920000   VOL92    SNGLVOL
0920101   0.   1.339     0.00580   0.   0.   0.   0.   0.   00
**********************
*
0940000   VOL94    SNGLVOL
0940101   0.   1.180     0.00256   0.  -45. -0.820     0.   0.   00
**********************
*
0950000   VOL95    BRANCH
0950001   0
0950101   0.   1.000     0.00336       0.   14.3   0.417   0.   0.   00
**********************
*
0960000   VOL96    BRANCH
0960001   0
0960101   0.   1.475     0.00620   0.   0.   0.   0.   0.   00
**********************
*
0970000   VOL97    PIPE
0970001   3
0970101   0.0  3
0970301   2.789 1    1.622     2    0.215     3
0970401   0.005530  1    0.00757   2    0.00226   3
0970601   5.4  1    0.   2   -90. 3
0970701   0.201  1    0.        2   -0.215     3
0970801   0.   0.   2   0.   0.006942  3
0970901   1.43  1.43  1   1.08   1.08   2
0971001   00  3
0971101   0000 1    0000 2
*
**********************
*
0910000   PUMP1    PUMP
0910101   0.          0.750       0.01010   0.   16.4 0.283     0
0910108   0730100000     0.00427   0.17        0.37        0000
0910109   0740000000     0.000988  3.00        1.00        0000
0910201   1    0.56   0.   0.
0910202   1    0.56   0.   0.
0910301   0    0    0   -1    0    0    0
0910302   383.69   0.540354   0.0383   50.   81.7    1.   1000.
0910303   0.   0.   0.   0.   0.
* NYA HOMOLOGA PUMPKURVOR, DATA KOMMER FRÅN ASEA-ATOM GÖRLIN-BER.
* TORQUE-KURVORNA SAKNAR BETYDELSE I DETTA FALL OCH HAR DÄRFÖR INTE
* KONTROLLERATS, RULLAN FÖR EN DEL DATA AR OKAND.
0911100   1    1
0911101   0.00+1.101     0.27+1.100     0.47+1.100
0911102   0.00+1.150     1.00+1.000
0911200   2    1
```

```
0911201   0.00+0.00      0.09+0.07      0.19+0.09
0911202   0.30+0.92      0.59+0.962     0.88+0.99      1.00+1.00
0911300   1    2
0911301   0.0+-0.569     0.41+-0.16     0.91+-0.05     0.78+0.48
0911302   1.00+1.00
0911400   2    2
0911401   0.0+-1.16      0.5+0.00       0.68+0.36      1.00+1.00
0911500   1    3
0911501   -1.00+2.00     -0.95+1.81     -0.62+1.52     -0.50+1.39
0911502   0.00+1.18
0911600   1    4
0911601   -1.00+2.00     -0.79+1.53     -0.63+1.25     -0.30+0.93
0911602   0.00+0.72
0911710   2    3
0911701   -1.00+3.31     -0.03+2.78     -0.00+2.29     -0.36+1.95
0911702   -0.37+1.49     -0.22+1.19     -0.18+0.99     0.00+0.84
0911800   2    4
0911801   -1.00+3.31     -0.79+2.78     -0.59+2.37     -0.41+2.04
0911802   -0.21+1.78     0.00+1.55
* TWO PHASE MULTIPLIER TABLES
2013000   0
2013001   0.0+0.0  0.1+0.0  0.15+0.05  0.2+0.0  0.3+0.96  0.4+0.98
2013002   0.0+0.97  0.0+0.9  0.9+0.8  0.96+0.5  1.0+0.0
2013100   0
2013101   0.0+0.0  0.1+0.0  0.15+0.05  0.2+0.0  0.3+0.96  0.4+0.98
2013102   0.0+0.97  0.0+0.9  0.9+0.8  0.96+0.5  1.0+0.0
* TWO PHASE DIFFERENCE FOR PUMP HEAD (SEMISCALE)
2016100   1    1
2016101   0.0+0.0  0.1+0.63  0.2+1.09  0.5+1.02  0.7+1.01  0.9+0.94  1.0+1.0
2016200   1    2
2016201   0.0+0.0  0.1+-0.04  0.2+0.0  0.3+0.1  0.4+0.21  0.8+0.67
2016202   0.9+0.88  1.0+1.0
2016300   1    3
2016301   -1.0+-1.16  -0.9+-1.24  -0.8+-1.77  -0.7+-2.36  -0.6+-2.79
2016302   -0.5+-2.91  -0.4+-2.67  -0.25+-1.69  -0.1+-0.5  0.0+0.0
2016400   1    4
2016401   -1.0+-1.16  -0.9+-0.78  -0.8+-0.5  -0.7+-0.31  -0.6+-0.17
2016402   -0.5+-0.08  -0.35+0.0  -0.2+0.05  -0.1+0.08  0.0+0.11
* TWO PHASE DIFFERENCE FOR PUMP TORQUE (= SINGLE PHASE, WHICH MEANS
* THAT FULLY DEGRADED TORQUE IS ZERO)
2016500   2    1
2016501   0.00+0.04      0.09+0.07      0.19+0.09
2016502   0.30+0.92      0.59+0.962     0.88+0.99      1.00+1.00
2015000   2    2
2015001   0.0+-1.16      0.5+0.00       0.68+0.36      1.00+1.00
2015100   2    3
2015101   -1.00+3.31     -0.03+2.78     -0.00+2.29     -0.36+1.95
2015102   -0.37+1.49     -0.22+1.19     -0.18+0.99     0.00+0.84
2015200   2    4
2015201   -1.00+3.31     -0.79+2.78     -0.59+2.37     -0.41+2.04
2015202   -0.21+1.78     0.00+1.55
** PUMP1 REGULATOR                                          *STEADY STATE CAND
2016100   501      CNTRLVAR  003                             *STEADY STATE CAND
2016101   0.   0.     1000.     1000.                        *STEADY STATE CAND
** PUMP1 CONTROL SYSTEM                                     *STEADY STATE CAND
205000100  MASSDIFF1  SUM        100.     0.          0   *STEADY STATE CAND
205000101  4.56     -1.0      MFLOWJ    ZERO0000        *STEADY STATE CA
205000200  INTEGRAL1  INTEGRAL  1.       0.          0   *STEADY STATE CAND
```

BEST COPY AVAILABLE

```
20500701  CNTRLVAR  001                                          *STEADY STATE CARD
20500300  VELDIFF1   SUM          1.          0.          1    *STEADY STATE CARD
20500301  184.54    1.0      CNTRLVAR  002                     *STEADY STATE CAR
*
**********************
*
2020000   PUMP2     PUMP
2020101   0.          0.700       0.00500    0.    72.0 0.220     0
2020100   0040100000      0.0019     0.35          0.35      0000
2020109   0050000000      0.000300   3.00          3.00      0000
2020201   1     1.55 0.    0.
2020202   1     1.55 0.    0.
2020301   0     0    -1    -1    0     0     0
2020302   383.69      0.7300S4    0.07056    25.       13.2      1.          1000
2020303   0.    0.   0.    0.    0.
2021100   1     1
2021101   0.0   1.136       0.2   1.135       0.4   1.120
2021102   0.0   1.100       0.8   1.055       1.0   1.000
2021200   2     1
2021201   0.0   0.51        1.0   1.00
2021300   1     2
2021301   0.0  -0.560       0.2  -0.305       0.4  -0.100       0.5  -0.055
2021302   0.0   0.165       0.8   0.565       1.0   1.000
2021400   2     2
2021401   0.0  -0.67        0.2  -0.21        0.4   0.07
2021402   0.0   0.35        0.8   0.66        1.0   1.00
2021500   1     3
2021501   -2.00:2.00       -0.95:1.01       -0.62:1.52       -0.50:1.39
2021502    0.00:1.136
2021600   1     4
2021601   -1.00:2.00       -0.79:1.53       -0.63:1.25       -0.30:0.93
2021602    0.00:0.72
2021700   2     3
2021701   -1.00:3.31       -0.83:2.78       -0.68:2.29       -0.56:1.95
2021702   -0.37:1.49       -0.22:1.19       -0.10:0.99        0.00:0.51
2021800   2     4
2021801   -1.00:3.31       -0.79:2.78       -0.59:2.37       -0.41:2.04
2021802   -0.21:1.78        0.00:1.55
2023000   0
2023001   0.0  0.00   0.1  0.00   0.2  0.05   0.3  0.00   0.4  0.00   0.5  0.00
2023002   0.0  0.97   0.7  0.00   0.8  0.00   0.9  0.50   1.0  0.00
2023100   0
2023101   0.0  0.00   0.1  0.10   0.2  0.15   0.3  0.24   0.4  0.30   0.5  0.40
2023102   0.6  0.60   0.7  0.00   0.8  0.00   0.9  0.96   1.0  1.00
** PUMP2 REGULATOR                                            *STEADY STATE CA
2026100   501       CNTRLVAR  006                             *STEADY STATE CARD
2026101   0.    0.          1000.      1000.                  *STEADY STATE CAR
** PUMP2 CONTROL SYSTEM                                       *STEADY STATE CARD
20500400  MASSDIFF2  SUM          100.       0.          0    *STEADY STATE CAR
20500401  1.55       -1.0      MFLOW2    202020000           *STEADY STATE CA
20500500  INTEGRAL2  INTEGRAL   1.          0.          0    *STEADY STATE CAR
20500501  CNTRLVAR   006                                     *STEADY STATE CARD
20500600  VELDIFF2   SUM          1.          0.          1    *STEADY STATE CAR
20500601  221.87     1.0      CNTRLVAR  005                   *STEADY STATE CA
*
**********************
*
1010000   JUN31-32  SNGL JUN
```

```
1010101   031010000 032000000 0.          0.          0.          1100
1010201   1           0.13      0.          0.
**********************
*
1020000   JUN32-33  SNGL JUN
1020101   032010000 033000000 0.          0.          0.          1100
1020201   1           9.51      0.          0.
**********************
*
1030000   JUN33-41  SNGL JUN
1030101   033010000 004000000 0.000473    0.430       0.200       0000
1030201   1           5.51      0.          0.
**********************
*
1040000   JUN41-51 SNGL JUN
1040101   004010000 051000000 0.          0.10        0.10        0100
1040201   1           3.75      1.76        0.
**********************
*
1050000   JUN51-52  SNGL JUN
1050101   051013000 052000000 0.          0.          0.          1100
1050201   1           4.35      1.76        0.
**********************
*
1060000   JUN52-21  SNGL JUN
1060101   052010000 021000000 0.03310     1.          1.          1020
1060201   1           4.35      1.76        0.
**********************
*
1070000   JUN11-21  SNGL JUN
1070101   011000000 021000000 0.0         0.0         0.0         1000
1070201   1           7.12      -1.76       0.
**********************
*
1080000   JUN12-11  SNGL JUN
1080101   012000000 011010000 0.          0.          0.          1000
1080201   1           7.12      -1.76       0.
**********************
*
1100000   JUN12-13  SNGL JUN
1100101   012010000 013000000 0.001432    0.95        0.95        1000    *STEADY ST
1100201   1           0.        0.          0.
**********************
*
1110000   JUN21-71  SNGL JUN
1110101   021010000 071000000 0.          1.00        1.00        1100
1110201   1           11.96     0.          0.
**********************
*
1120000   JUN71-72  SNGL JUN
1120101   071010000 072000000 0.          0.          0.          1000
1120201   1           11.96     0.          0.
**********************
*
1130000   JUN72-73  SNGL JUN
1130101   072010000 073000000 0.00        0.          0.          1000
1130201   1           0.96      0.          0.
**********************
```

```
*
1160000   JUN74-31  SNGL JUN
1160101   074010000 031010000 0.          0.00        0.00        1100
1160201   1           4.56      0.          0.
**********************
*
1170000   BY-PASS   VALVE
1170101   032010000 064000000 0.000501    0.          0.          0000
1170201   1           0.60      0.          0.
1170300   MIXVLV    *    MOTORVALVE IN BY-PASS INLET
1170301   0000503   0000502   0.02        0.1924
1170400   1.0  34.29
1170401   .000 .000 .050 .125 .0986 .0986 .288 .1301 .1301
1170402   .508 .1955 .1955 1.00 .2037 .2037
**********************
*
1180000   JUN64-62  SNGL JUN
1180101   064000000 062000000 0.00476     0.          0.          1100
1180201   1           0.        0.          0.
**********************
*
1200000   JUN64-51  SNGL JUN
1200101   064010000 051010000 0.001790    2.00        2.00        0000
1200201   1           0.60      0.          0.
**********************
*
1220000   JUN72-91  SNGL JUN
1220101   072010000 091000000 0.          0.00        0.00        0100
1220201   1           1.55      0.          0.
**********************
*
1230000   JUN91-94  SNGL JUN
1230101   091010000 094000000 0.          0.00        0.00        0100
1230201   1           1.55      0.          0.
**********************
*
1240000   JUN91-92  SNGL JUN
1240101   091010000 092000000 0.          0.00        0.00        0000
1240201   1           0.        0.          0.
**********************
*
1250000   JUN95-97  SNGL JUN
1250101   095010000 097000000 19.0E-6     12.5        12.5        0000
1250201   1           1.55      0.          0.
**********************
*
*1260000   JUN951-9; SNGL JUN
*1260101   095000000 096000000 0.          1.00        1.00        0100
*1260201   1           0.        0.          0.
**********************
*
1270000   JUN950-96 SNGL JUN
1270101   095010000 096000000 0.          1.00        1.00        0100
1270201   1           0.        0.          0.
**********************
*
1280000   JUN97-31  SNGL JUN
```

```
1200101  097000000 031010000 0.        0.00      0.00      0100
1200201  1          1.55      0.        0.
*
* COOLING SYSTEM
************************
*
3010000  COOLING       TMDPVOL
3010101  0.003959  1.   0.   0.   0.   0.   0.   0.        10
3010200  2
3010201  0.        7000000.  0.
************************
*
4010000  COOLING       TMDPJUN
4010101  072000000       301000000       0.
4010200  1     504
4010201  0.   7.85    0.   0.   1.78 7.85    0.   0.   2.0  0.   0.   0.
************************
*
3020000  SPRAYFLOW      TMDPVOL
3020101  0.002525  1.   0.   0.   90.   1.   0.   0.02576   10
3020200  3
3020201  0.        7500000.  454.8
************************
*
4020000  SPRAYFLOW      TMDPJUN
4020101  302000000       012010000       0.
4020200  1  504
4020201  0.   5.36    0.   0.   1.65 5.36    0.   0.   1.0  0.   0.   0.
************************
*
3030000  SUBCOOLING     TMDPVOL
3030101  0.000531  1.   0.   0.   0.   0.   0.   0.        10
3030200  3
3030201  0.        7500000.  454.8
************************
*
4030000  SUBCOOLING     TMDPJUN
4030101  303000000       021010000       0.
4030200  1  504
4030201  0.   2.4900 0.   0.   1.0  2.4900 0.   0.   2.0  0.   0.   0.
*
* STEAM RELIEF
************************
*
3040000  RELIEF    TMDPVOL
3040101  0.00036   1.   0.   0.   90.   1.   0.   0.   00   *STEADY STATE
3040200  2
3040201  0.        7000000.  1.0   *STEADY STATE CARD
*
*4040000  RELIEF    VALVE                                          *OLD MODEL
*4040101  013010000 304000000 0.000094  0.   0.   0100           *OLD MODEL
*4040201  1    0.   0.   0.                                        *OLD MODEL
*4040300  MTRVLV  *MOTORVALVE                                     *OLD MODEL
*4040301  10E3602   8888884   3.33  0.                            *OLD MODEL
*
*********************
*
*4040000  DOMECNTRL SNGLJUN   *STEADY STATE CARD
```

```
4040101  013010000       304000000       0.   0.   0.  1000  *STEADY S
4040201  1    0.   0.   0.   *STEADY STATE CARD
*
* DUMP VOLUMES
************************
*
5020000  DUMP3     TMDPVOL
5020101  1.00      1.00      0.   0.   0.   0.   0.   0.   00
5020200  2
5020201  0.   100000.   1.0
*
* SPLIT RUPTURE IN CIRCULATION LINE
************************
*
1520000  BREAK     VALVE
1520101  090010000 502000009   0.0001131 0.   0.   0100  0.85  0.85 *
1520201  1    0.   0.   0.
1520300  MTRVLV
1520301  0000504   0000505   5.00      0.0   *OPENING TIME .20 SEC
*
*
* HEAT STRUCTURES
14010000       1    7    2    1    0.          * CORE
14010100       0    1
14010101       4  0.004725    2  0.006125
14010201       1  4           -2  4
14010301       0.0  4          1.0  4
14010400       0
14010401       578. 7
14010501       0         0    0    1    13.248    1
14010601       004010000 0    1    1    13.248    1
14010701       1    0.0764    0.   0.   1
14010901       10  0.01742    0.   0.   1
14020000       1    7    2    1    0.
14020100       0    1
14020101       4  0.005175    2  0.006125
14020201       1  4           -2  4
14020301       0.0  4          1.0  4
14020400       4010
14020501       0         0    0    1    13.248    1
14020601       004020000 0    1    1    13.248    1
14020701       1    0.1038    0.   0.   1
14020901       10  0.01742    0.   0.   1
14030000       1    7    2    1    0.
14030100       0    1
14030101       4  0.005275    2  0.006125
14030201       1  4           -2  4
14030301       0.0  4          1.0  4
14030400       4010
14030501       0         0    0    1    13.248    1

14030601       004030000 0    1    1    13.248    1
14030701       1    0.1138    0.   0.   1
14030901       10  0.01742    0.   0.   1
14040000       1    7    2    1    0.
14040100       0    1
14040101       4  0.005375    2  0.006125
14040201       1  4           -2  4
```

```
14040301       0.0  4          1.0  4
14040400       4010
14040501       0         0    0    1    13.248    1
14040601       004040000 0    1    1    13.248    1
14040701       1    0.1288    0.   0.   1
14040901       10  0.01742    0.   0.   1
14050000       1    7    2    1    0.
14050100       4040
14050400       4010
14050501       0         0    0    1    13.248    1
14050601       005050000 0    1    1    13.248    1
14050701       1    0.1190    0.   0.   1
14050901       10  0.01742    0.   0.   1
14060000       1    7    2    1    0.
14060100       4030
14060400       4010
14060501       0         0    0    1    13.248    1
14060601       006060000 0    1    1    13.248    1
14060701       1    0.1133    0.   0.   1
14060901       10  0.01742    0.   0.   1
14070000       1    7    2    1    0.
14070100       4030
14070400       4010
14070501       0         0    0    1    13.248    1
14070601       007070000 0    1    1    13.248    1
14070701       1    0.1130    0.   0.   1
14070901       10  0.01742    0.   0.   1
14080000       1    7    2    1    0.
14080100       4020
14080400       4010
14080501       0         0    0    1    13.248    1
14080601       008080000 0    1    1    13.248    1
14080701       1    0.1026    0.   0.   1
14080901       10  0.01742    0.   0.   1
14090000       1    7    2    1    0.
14090100       0    1
14090101       4  0.005975    2  0.006125
14090201       1  4           -2  4
14090301       0.0  4          1.0  4
14090400       4010
14090501       0         0    0    1    13.248    1
14090601       009090000 0    1    1    13.248    1
14090701       1    0.0877    0.   0.   1
14090901       10  0.01742    0.   0.   1
14100000       1    7    2    1    0.
14100100       0    1
14100101       4  0.006025    2  0.006125
14100201       1  4           -2  4
14100301       0.0  4          1.0  4
14100400       4010
14100501       0         0    0    1    13.248    1
14100601       010100000 0    1    1    13.248    1
14100701       1    0.0514    0.   0.   1
14100901       10  0.01742    0.   0.   1
*
10440000       1    7    2    1    0.   * BY PASS
10440100       0    1
10440101       1  0.004125
```

BEST COPY AVAILABLE

BEST COPY AVAILABLE

```
10640201       2   1
10640301       1.0 1
10640400       8
10640401       570. 2
10640501       0          0   0   1   2.67      1
10640601       0640160000 0   1   1   2.67      1
10640701       2    0.25       0.        0.        1
10640901       3    0.         0.        0.        1
*    HYDR DIA IN HEAT AND HYDR STRUCTURE THE SAME
10650000       1    2    2    1    0.
10650100       0640
10650400       5640
10650501       0          0   0   1   2.67      1
10650601       0640200000 0   1   1   2.67      1
10650701       2    0.48       0.        0.        1
10650901       0    0.01762    0.        0.        1
10660000       1    2    2    1    0.
10660100       0640
10660400       0640
10660501       0          0   0   1   2.67      1
10660601       0640300000 0   1   1   2.67      1
10660701       2    0.27       0.        0.        1
10660901       0    0.01762    0.        0.        1
*
*
* BOX WALL TO ACCOUNT FOR HEAT LOSSES
14000000   10   2   1   1   0.
14000100    0   1
14000101    1   0.002
14000201    3   1
14000301    0.  1
14000401  450.  1
14000402  560.  2
14000501  -401              -1  3400   0   0.15     10
14000601   0040160000  010000      1   0   0.15     10
14000701    0   0.   0.   0.      10
14000901    0   0.   0.   0.      10
*
*  GENERAL TABLE GIVING HEAT TRANSFER COEFF. AT OUTSIDE OF BOX WALL.
*
*  GENERAL TABLES GIVING THE TEMPERATURES AT THE OUTSIDE OF THE
*  BOX WALL. TEMPERATURE IS SUPPOSED TO VARY LINEARLY BETWEEN 403 K
*  AT INLET TO 493 K AT OUTLET.
*
20240000   HTC-1
20240001   0.    1.7213E3  * HTC DETERMINED TO GIVE HEAT LOSS OF APP
*
20240100   TEMP
20240101   0.    407.5
*
20240200   TEMP
20240201   0.    410.5
*
20240300   TEMP
20240301   0.    425.5
*
20240400   TEMP
20240401   0.    436.5

20240500   TEMP
20240501   0.    443.5
*
20242688   TEMP
20240601   0.    452.5
*
20240700   TEMP
20240701   0.    461.5
*
20240800   TEMP
20240801   0.    470.5
*
20240900   TEMP
20240901   0.    479.5
*
20241000   TEMP
20241001   0.    488.5
*
*
13.00000   1   4   1   1   0.00
13100100   0   2
13100101   0.005  1   0.015  2   0.00  3
13100201   3   3
13100301   .0  3
13100421   560.  4
13100501   31010000  0   1   0   .179   1
13100601  -13   0  3014  0    .179   1
13100701   0   .0   .0   .0   1
13100801   0   .0   .0   .0   1
*
13200000   1   4   2   1   .132
13200100   0   2
13200101   0.005  1   0.015  2   0.01  3
13200201   3   3
13200301   .0  3
13200401   560.  4
13200501   32010000  0   1   1   .325   1
13200601  -13   0  3014  1    .325   1
13200701   0   .0   .0   .0   1
13200801   0   .0   .0   .0   1
*
13300000   1   4   2   1   .132
13300100   0   2
13300101   0.005  1   0.015  2   0.03  3
13300201   3   3
13300301   .0  3
13300401   560.  4
13300501   33010000  0   1   1   .271   1
13300601  -13   0  3014  1    .271   1
13300701   0   .0   .0   .0   1
13300801   0   .0   .0   .0   1
*
15100000   1   3   2   1   .132
15100100   0   1
15100101   2   .102
15100201   3   2
15100301   .0  2

15100401   560.  3
15100501   51010000  0   1   1   .179   1
15100601  -13   0  3014  1    .179   1
15100701   0   .0   .0   .0   1
15100801   0   .0   .0   .0   1
*
15210000   1   3   2   1   .063
15210100   0   1
15210101   2   .065
15210201   3   2
15210301   .0  2
15210401   560.  3
15210501   52110000  0   1   1   .037   1
15210601   0    0    0    1   .037   1
15210701   0   .0   .0   .0   1
15210801   0   .0   .0   .0   1
*
15220000   1   3   2   1   .050
15220100   0   1
15220101   2   .052
15220201   3   2
15220301   .0  2
15220401   560.  3
15220501   52020000  0   1   1   .053   1
15220601   0    0    0    1   .053   1
15220701   0   .0   .0   .0   1
15220801   0   .0   .0   .0   1
*
11100000   1   4   2   1   .250
11100100   0   2
11100101   0.005  1   0.015  2   0.033  3
11100201   3   3
11100301   .0  3
11100401   560.  4
11100501   11013000  0   1   1   .458   1
11100601  -13   0  3014  1    .458   1
11100701   0   .0   .0   .0   1
11100801   0   .0   .0   .0   1
*
11210000   1   4   2   1   .250
11210100   0   2
11210101   0.005  1   0.015  2   0.033  3
11210201   3   3
11210301   .0  3
11210401   560.  4
11210501   12010000  0   1   1   2.288   1
11210601  -13   0  3014  1    2.288   1
11210701   0   .0   .0   .0   1
11210801   0   .0   .0   .0   1
*
11220000   1   4   1   1   0.00
11220100   0   2
11220101   0.005  1   0.015  2   0.033  3
11220201   3   3
11220301   .0  3
11220401   560.  4
11220501   12020000  0   1   0   .000   1
11220601  -13   0  3014  0    .000   1
```

BEST COPY AVAILABLE

```
11220701  0  .0  .0  .0  1
11220801  0  .0  .0  .0  1
*
12110000  1  4  1  1  .250
12110100  0  2
12110101  0.005  1  0.015  2  0.033  3
12110201  3  3
12110301  .0  3
12110401  500.  4
12110501  210010000  0  1  1  .484  1
12110601 -13  0  3014  1  .484  1
12110701  0  .0  .0  .0  1
12110801  0  .0  .0  .0  1
*
12120000  1  4  2  1  .170
12120100  0  2
12120101  0.005  1  0.015  2  0.033  3
12120201  3  3
12120301  .0  3
12120401  500.  4
12120501  210020000  0  1  1  .569  1
12120601 -13  0  3014  1  .569  1
12120701  0  .0  .0  .0  1
12120801  0  .0  .0  .0  1
*
12130000  1  4  2  1  .132
12130100  0  2
12130101  0.005  1  0.015  2  0.01  3
12130201  3  3
12130301  .0  3
12130401  500.  4
12130501  210030000  0  1  1  .286  1
12130601 -13  0  3014  1  .286  1
12130701  0  .0  .0  .0  1
12130801  0  .0  .0  .0  1
*
12140000  1  4  2  1  .132
12140100  0  2
12140101  0.005  1  0.015  2  0.01  3
12140201  3  3
12140301  .0  3
12140401  500.  4
12140501  210040000  0  1  1  .144  1
12140601 -13  0  3014  1  .144  1
12140701  0  .0  .0  .0  1
12140801  0  .0  .0  .0  1
*
17100000  0  3  2  1  .0540
17100100  0  1
17100101  2  .0707
17100201  3  2
17100301  .0  2
17100401  500.  3
17100501  710164000  010000  1  1  0.998  3
17100502  710040000  010000  1  1  0.870  4
17100601 -13  0  3014  1  0.998  3
17100602 -13  0  3014  1  0.870  4
17100701  0  .0  .0  .0  0

17100801  0  .0  .0  .0  0
*
17200000  1  3  2  1  .0540
17200100  0  1
17200101  2  .0707
17200201  3  2
17200301  .0  2
17200401  500.  3
17200501  72010000  0  1  1  .389  4
17200601 -13  0  3014  1  .388  1
17200701  0  .0  .0  .0  1
17200801  0  .0  .0  .0  1
*
17300000  1  3  2  1  .0540
17300100  0  1
17300101  2  .0707
17300201  3  2
17300301  .0  2
17300401  500.  3
17300501  73010000  0  1  1  .716  1
17300601 -13  0  3014  1  .716  1
17300701  0  .0  .0  .0  1
17300801  0  .0  .0  .0  1
*
17400000  4  3  2  1  .0369
17400100  0  1
17400101  2  .0445
17400201  3  2
17400301  .0  2
17400401  500.  3
17400531  74010000  0  1  1  .573  1
17400502  74020000  0  1  1  1.117  2
17400503  74030000  0  1  1  2.076  3
17400504  74040000  0  1  1  1.588  4
17400601 -13  0  3014  1  .573  1
17400602 -13  0  3014  1  1.117  2
17400603 -13  0  3014  1  2.076  3
17400604 -13  0  3014  1  1.588  4
17400701  0  .0  .0  .0  4
17400801  0  .0  .0  .0  4
*
17450000  1  3  1  1  0.00
17450100  0  1
17450101  2  .043
17450201  3  2
17450301  .0  2
17450401  500.  3
17450501  74050000  0  1  0  .055  1
17450601 -13  0  3014  0  .055  1
17450701  0  .0  .0  .0  1
17450801  0  .0  .0  .0  1
*
18200000  1  3  2  1  .0475
18200100  0  1
18200101  2  .0995
18200201  3  2
18200301  .0  2
18200401  500.  3

18200501  82010000  0  1  1  1.221  1
18200601 -13  0  3014  1  1.221  1
18200701  0  .0  .0  .0  1
18235801  0  .0  .0  .0  1
*
18400000  3  3  2  1  .0486
18400100  0  1
18400101  2  .0572
18400201  3  2
18400301  .0  2
18400401  500.  3
18400501  84010000  0  1  1  1.448  1
18400502  84020000  0  1  1  1.335  2
18400503  84030000  0  1  1  1.363  3
18400601 -13  0  3014  1  1.448  1
18400602 -13  0  3014  1  1.335  2
18400603 -13  0  3014  1  1.363  3
18400701  0  .0  .0  .0  3
18400801  0  .0  .0  .0  3
*
19100000  .  3  2  1  .0369
19100100  0  1
19100101  2  .0445
19100201  3  2
19100301  .0  2
19100401  500.  3
19100501  91010000  0  1  1  1.246  1
19100601 -13  0  3014  1  1.246  1
19100701  0  .0  .0  .0  1
19100801  0  .0  .0  .0  1
*
19200000  1  3  2  1  .0369
19200100  0  1
19200101  2  .0445
19200201  3  2
19200301  .0  2
19200401  500.  3
19200501  92010000  0  1  1  1.339  1
19200601 -13  0  3014  1  1.339  1
19200701  0  0.  0.  0.  1
19200801  0  0.  0.  0.  1
*
19400000  1  3  2  1  .0744
19400100  0  1
19400101  2  .0301
19400201  3  2
19400301  .0  2
19400401  500.  3
19400501  94010000  0  1  1  1.188  1
19400601 -13  0  3014  1  1.188  1
19400701  0  .0  .0  .0  1
19400801  0  .0  .0  .0  1
*
19500000  1  3  2  1  .0744
19500100  0  1
19500101  2  .0301
19500201  3  2
19500301  .0  2
```

```
19500401  560.  3
19500501  95010000  0   1   1   1.603   1
19500601 -13   0  3014  1    1.693   1
19500701  0   .0   .0   .0   1
19500801  0   .0   .0   .0   1
*
19600000  1   3   2   1    .0369
19600100  0   1
19600101  2   .0045
19600201  3   2
19600301  .0  2
19600401  560.  3
19600501  96010000  0   1   1   1.675   1
19600601 -13   0  3014  1    1.675   1
19600701  0          0.  0.  0.          1
19600801  0          0.  0.  0.          1
*
19710000  1   3   2   1    .0246
19710100  0   1
19710101  2   .0381
19710201  3   2
19710301  .0  2
19710401  560.  3
19710501  97010000  0   1   1   2.780   1
19710601 -13   0  3014  1    2.780   1
19710701  0   .0   .0   .0   1
19710801  0   .0   .0   .0   1
*
19720000  1   3   2   1    .0486
19720100  0   1
19720101  2   .050
19720201  3   2
19720301  .0  2
19720401  560.  3
19720501  97020000  0   1   1   1.420   1
19720601 -13   0  3014  1    1.420   1
19720701  0   .0   .0   .0   1
19720801  0   .0   .0   .0   1
*
19730000  1   3   1   1    0.00
19730100  0   1
19730101  2   .003
19730201  3   2
19730301  .0  2
19730401  560.  3
19730501  97030000  0   1   0   .055   1
19730601 -13   0  3014  0    .055   1
19730701  0   .0   .0   .0   1
19730801  0   .0   .0   .0   1
*
12010000  1   3   1   1    0.00
12010100  0   1
12010101  2   .020
12010201  3   2
12010301  .0  2
12010401  560.  3
12010501  201010000  0   1   0   0.50   1
12010601 -13   0  3014  0    0.50   1
```

```
12010701  0   .0   .0   .0   1
12010801  0   .0   .0   .0   1
*
12020000  1   3   1   1    0.00
12020100  0   1
12020101  2   .020
12020201  3   2
12020301  .0  2
12020401  560.  3
12020501  202010000  0   1   0   0.300  1
12020601 -13   0  3014  0    0.30   1
12020701  0   .0   .0   .0   1
12020801  0   .0   .0   .0   1
*
13110000        3    4    2    1    0.          * COPPER HOOS
13110100        0    1
13110101        3  0.0045    2  0.0070
13110201        1    3              4   5
13110301        0.0 5
13110400        0
13110401        570. 6
13110501        0          0    3    1    5.48    1
13110502        0          0    3    1   11.78    2
13110503        0          0    3    1    9.80    3
13210601        031010000  0    1    1    5.48    1
13110602        032010000  0    1    1   11.78    2
13110603        033010000  0    1    1    9.80    3
13110701        0     0.00       0.   0.    5
13110901        00  0.01742       0.   0.    3
15110000        1    4    2    1    0.          * COPPEN CABLES
15110100        0    1
15110101        4  0.004
15110201        4  4
15110301        0.0 4
15110400        0
15110401        470. 4
15110501        0          0    0    1    7.40    1
15110601        051010000  0    1    1    7.40    1
15110701        0     0.00       0.   0.    1
15110901        00  0.01742       0.   0.    1
*
*
20100100  TBL/FCTN  1   -1     *  HB 0
20100101          673. 4.58       573. 0.65       673. 3.75       773. 3.10
20100102          873. 2.75       973. 2.58      1073. 2.38
20100151          3300000.   3100300.   3320000.   3405000.
20100152          3630000.   3713000.   3748000.
*
20101200  TBL/FCTN  2    2     *  INCONEL 600
20100201  293. 1000.      10.97*     0.0122     0.000002862 0. 0. 0. 0.
20100251  293. 1000.      7665370.   4173.5    -1.7242      0. 0. 0. 0.
*
20100300  S-STEEL
*
20100400  TBL/FCTN    1  1     * COPPER
20100401  300.0
20100451  5.48E-06
```

```
*
*
* CORE POWER REDUCTION
20200100  POWER    584          1.          3.385E6
20200101   0.00 1.000  0.25 0.995  2.00 0.721  5.00 0.452
20200102   7.50 0.337  10.0 0.232  12.5 0.165  15.0 0.125 20.0 0.083
20200103  25.00 0.067 30.00 0.062 50.00 0.050 75.00 0.055 200.0 0.055
* BY-PASS POWER REDUCTION
20200250  POWER    584          1.          57.6E3
20200251   0.00 1.000  1.00 0.552  2.00 0.469  5.00 0.402
20200252  10.00 0.286 15.00 0.052 20.00 0.016 25.00 0.012 200.00 0.012
*
*
*LIQUID LEVEL IN DOWE DC ANNULUS AND DOWNCOMER TO BREAK
*HEIGHT OF LIQUID = FCT OF LIQUID VOID
20201100  NORMAREA          *VOLZ1-2
20201101   0.    0.    .2960      .2760      1.0        0.549
20201200  NORMAREA          *VOLZ1-3
20201201   0.    0.    0.494      0.150      1.0        0.286
20201300     TEMP
20201301   0.      298.
20201400   HTC-1
20201401    0.      10.04      * \\ AUXILIARY HEAT TRANSFER COEFF.
20501100  LIQM21-2          FUNCTION  1.    0.    1
20501101  VOIDF       021020000       011
20501200  LIQM21-3          FUNCTION  1.    0.    1
20501201  VOIDF       021030000       012
20504100  LIQLEVDC            SUM       1.    0.    1
20504101  1.115    0.389          VOIDF       072010000
20504102  0.020                   VOIDF       071040000
20504103  0.020                   VOIDF       071070000
20504104  0.020                   VOIDF       071060000
20504105  0.020                   VOIDF       071050000
20504106  0.020                   VOIDF       071040000
20504107  .146                    VOLOF       021040000
20504108  1.                      CNTRLVAR    012
20504109  1.                      CNTRLVAR    011
20504110          0.404           VOIDF       021010000
*LIQUID LEVEL IN UPPER PLENUM AND STEAM PIPE
*HEIGHT OF LIQUID = FCT OF LIQUID VOID
20202100  NORMAREA          **LSZ-1
20202101  0.    0.    0.150      0.023      0.336      0.000
20202102  0.494    0.230      0.075      0.389      1.0        0.525
20502100  LIQM52-1          FUNCTION  1.    0.    1
20502.01  VOIDF       052010000       021
20504200  LIQLEVUP            SUM       1.    0.    1
20504201  0.    0.178         VOIDF       051010000
20504202  1.0                 CNTRLVAR    021
20504203  0.052               VOIDF       052020000
*LIQUID LEVEL IN CORE
20504300  LIQLCORE            SUM       0.360      0.    1
20504301  0.    1.            VOIDF       004010000
20504302  1.                  VOIDF       004020000
20504303  1.                  VOIDF       004030000
20504304  1.                  VOIDF       004040000
20504305  1.                  VOIDF       004050000
20504306  1.                  VOIDF       004060000
20504307  1.                  VOIDF       004070000
```

BEST COPY AVAILABLE

BEST COPY AVAILABLE

```
20504300  1.          VOIDF      004000000
20504309  1.          VOIDF      004000000
20504310  1.          VOIDF      004100000
*LIQUID LEVEL IN LOWER PLENUM
20504400  LEVLEVLP     SUM        1.   0.   1
20504401  0.   0.150    VOIDF     031010000
20504402  0.325        VOIDF     32010000
20504403  0.271        VOIDF     33010000
*
*ROD CLADDING TEMP SAVE UP
20506100  CLADTEMP1      MULT      1.   0.   1
20506101  HTTEMP    401000105      *ROD CLADDING INNER TEMP VOL1
20506200  CLADTEMP2      MULT      1.   0.   1
20506201  HTTEMP    402000105      *ROD CLADDING INNER TEMP VOL2
20506300  CLADTEMP3      MULT      1.   0.   1
20506301  HTTEMP    403000105      *ROD CLADDING INNER TEMP VOL3
20506400  CLADTEMP4      MULT      1.   0.   1
20506401  HTTEMP    404000105      *ROD CLADDING INNER TEMP VOL4
20506500  CLADTEMP5      MULT      1.   0.   1
20506501  HTTEMP    405000105      *ROD CLADDING INNER TEMP VOL5
20506600  CLADTEMP6      MULT      1.   0.   1
20506601  HTTEMP    406000105      *ROD CLADDING INNER TEMP VOL6
20506700  CLADTEMP7      MULT      1.   0.   1
20506701  HTTEMP    407000105      *ROD CLADDING INNER TEMP VOL7
20506800  CLADTEMP8      MULT      1.   0.   1
20506801  HTTEMP    408000105      *ROD CLADDING INNER TEMP VOL8
20506900  CLADTEMP9      MULT      1.   0.   1
20506901  HTTEMP    409000105      *ROD CLADDING INNER TEMP VOL9
20507000  CLADTEMP10     MULT      1.   0.   1
20507001  HTTEMP    410000106      *ROD CLADDING MIDDLE TEMP VOL10
*
*HEAT TRANSFER COEFF (HEAT RATE/(SURFACE TEMP-FLUID TEMP))
20508100  HTCOEF1   SUM        1.   0.   1
20508101     0.     1.          HTHTC    401000101
20508200  HTCOEF2   SUM        1.   0.   1
20508201     0.     1.          HTHTC    402000101
20508300  HTCOEF3   SUM        1.   0.   1
20508301     0.     1.          HTHTC    403000101
20508400  HTCOEF4   SUM        1.   0.   1
20508401     0.     1.          HTHTC    404000101
20508500  HTCOEF5   SUM        1.   0.   1
20508501     0.     1.          HTHTC    405000101
20508600  HTCOEF6   SUM        1.   0.   1
20508601     0.     1.          HTHTC    406000101
20508700  HTCOEF7   SUM        1.   0.   1
20508701     0.     1.          HTHTC    407000101
20508800  HTCOEF8   SUM        1.   0.   1
20508801     0.     1.          HTHTC    408000101
20508900  HTCOEF9   SUM        1.   0.   1
20508901     0.     1.          HTHTC    409000101
20509000  HTCOEF10  SUM        1.   0.   1
20509001     0.     1.          HTHTC    410000101
* LIQUID LEVEL CONTROL SYSTEM FOR BC (STEADY STATE ONLY)
3050000   LEVCTRVOL    THDPVOL
3050101   1.   1.   0.   0.   0.   0.   0.   0.   99
3050200   2
3050201   0.     7.376   0.
4050000   LEVCTRJUN    THDPJUN
```

```
4050101   305000000   021010000   0.2
4050200   0     0     CNTRLVAR  049
4050201   -0.2      -0.2      0.   0.
4050202    0.2       0.2      0.   0.
20504000  LEVCTR    SUM       2.   0.   0
20504001  0.349     -1.       CNTRLVAR  041
*
*
*
20505030    STR-HTLOSS     SUM      1.     0.     0
20505001  0.     .17900      HTRNR    310000100
20505002       .26952      HTRNR    320000100
20505003       .22478      HTRNR    330000100
20505004       .14066      HTRNR    510000100
20505005       .17298      HTRNR    521000100
20505006       .29939      HTRNR    522000100
20505007       .71963      HTRNR    111000100
20505008      3.45575      HTRNR    121000100
20505009       .48888      HTRNR    122000100
20505010       .83460      HTRNR    211000100
20505011       .58641      HTRNR    212000100
20505012       .23721      HTRNR    213000100
20505013       .12109      HTRNR    214000100
20505014       .34343      HTRNR    710000100
20505015       .34343      HTRNR    710000200
20505016       .34343      HTRNR    710000300
20505017       .28234      HTRNR    710000400
20505018       .28234      HTRNR    710000500
20505019       .28234      HTRNR    710000600
20505020       .28234      HTRNR    710000700
20505100    STR-HTLOSS     SUM      1.     0.     0
20505101  0.     .28234      HTRNR    710000800
20505102       .10338      HTRNR    720000100
20505103       .26453      HTRNR    730000100
20505104       .13285      HTRNR    740000100
20505105       .25808      HTRNR    740000200
20505106       .66634      HTRNR    740000300
20505107       .36632      HTRNR    740000400
20505108       .55008      HTRNR    745200100
20505109       .67128      HTRNR    620000100
20505110       .43972      HTRNR    640000100
20505111       .40766      HTRNR    640000200
20505112       .41621      HTRNR    640000300
*20505113       .28889      HTRNR    910000100
20505113       .14445      HTRNR    910000100
20505114       .58888      HTRNR    261000100
20505115       .49516      HTRNR    920010100
20505116  0.24   HTRNR    311000101
20505117  0.51   HTRNR    311000261
20505118  0.63   HTRNR    311000301
20505119  0.28   HTRNR    911000101
2050*120       .30000      HTRNR    202000100
*
20505200    STR-HTLOSS     SUM      1.     0.     0
20505201  0.     .11865      HTRNR    920000100
20505202       .34198      HTRNR    965000100
20505300    TOTAL     SUM      1.     0.     0
20504101  0.   1.   CNTRLVAR  50
```

```
20505302       1.   CNTRLVAR 51
20505303       1.   CNTRLVAR 52
*
20505400  STR-HINT   INTEGRAL   1.   0.   0
20505401  CNTRLVAR  50
*
20505500  BREAK-LOSS   INTEGRAL   1.   0.   0
20505501  MFLOWJ   152000000
*
20505600    BOA-HTLOSS     SUM      1.     0.     0
20505601  0.     .150        HTRNR    400000100
20505602       .150        HTRNR    400000200
20505603       .150        HTRNR    400000300
20505604       .150        HTRNR    400000400
20505605       .150        HTRNR    400000500
20505606       .150        HTRNR    400000600
20505607       .150        HTRNR    400000700
20505608       .150        HTRNR    400000800
20505609       .150        HTRNR    400000900
20505610       .150        HTRNR    400001000
*
20505700    COR-POW        FUNCTION    1.          0.     0
20505701    TIME    0        001
*
20505800    BYPASS-POW     FUNCTION    1.          0.     0
20505801    TIME    0        002
*
20505900    TOT-POW        SUM      1.     0.     0
20505901  0.          1.   CNTRLVAR 57
20505902              1.   CNTRLVAR 58
20511000    AUX-HTLOSS     SUM      1.     0.     0
20511001  0.     .17900      HTRNR    310000101
20511002       .33881      HTRNR    320000101
20511003       .30990      HTRNR    330000101
20511004       .10220      HTRNR    510000101
20511007       .07194      HTRNR    110000101
20511008      4.08037      HTRNR    121000101
20511009       .48888      HTRNR    122000101
20511010       .76914      HTRNR    211000101
20511011       .76923      HTRNR    212000101
20511012       .29111      HTRNR    213000101
20511013       .14061      HTRNR    214000101
20511014       .44333      HTRNR    710000101
20511015       .44333      HTRNR    710000201
20511016       .44333      HTRNR    710000301
20511017       .30626      HTRNR    710000401
20511018       .30626      HTRNR    710000501
20511019       .30626      HTRNR    710000601
20511020       .30626      HTRNR    710000701
*
20511100    AUX-HTLOSS     SUM      1.     0.     0
20511101  0.     .30626      HTRNR    710000801
20511102       .13327      HTRNR    720000101
20511103       .31806      HTRNR    730000101
20511104       .10021      HTRNR    740000101
20511105       .31232      HTRNR    740000201
20511106       .80348      HTRNR    740000301
20511107       .40179      HTRNR    740000401
```

BEST COPY AVAILABLE

```
20511108          .05588     HTRNR    765000101
20511109          .76336     HTRNR    620000101
20511110          .91793     HTRNR    640000101
20511111          .47900     HTRNR    660000201
20511112          .48986     HTRNR    660000301
20511113          .36838     HTRNR    910000101
20511114          .22468     HTRNR    940000101
20511115          .31038     HTRNR    960000102
20511116          .52576     HTRNR    971000101
20511117          .44611     HTRNR    972000102
20511118          .05588     HTRNR    973000101
20511119          .58000     HTRNR    201000101
20511120          .38000     HTRNR    202000101
*
20511200    AUX-HTLOSS   SUM    1.    0.    0
20511201  0.    .37639     HTRNR    920000101
20511202          .61241     HTRNR    940000101
*
20511300    TT-AUX-HTL   SUM    1.    0.    0
20511301  0.     1.     CNTRLVAR 110
20511302          1.     CNTRLVAR 111
20511303          1.     CNTRLVAR 112
*
*
********** INITIAL VALUES
*
0310200   3    7117380.  541.74
0320200   3    7115560.  541.77
0330200   3    7113360.  541.80
0510200   2    7038120.  0.10841
0130200   2    7008700.  1.0
0720200   3    7041360.  541.79
0730200   3    7045300.  541.78
0620200   3    7073580.  540.48
0910200   3    7042680.  541.71
0920200   3    7042750.  541.62
0940200   3    7045350.  541.65
0950200   3    7126980.  541.65
0960200   3    7123710.  541.77
2010200   3    7112300.  541.82
2020200   3    7104330.  541.78
0841201   3    7072590.  556.84    0.    0.    0.   1
0841202   2    7069360.  0.694216  0.    0.    0.   2
0841203   2    7066310.  0.627667  0.    0.    0.   3
0841204   2    7063590.  0.598825  0.    0.    0.   4
0841205   2    7059960.  0.655152  0.    0.    0.   5
0841206   2    7056080.  0.676705  0.    0.    0.   6
0841207   2    7051950.  0.693267  0.    0.    0.   7
0841208   2    7047590.  0.13705   0.    0.    0.   8
0841209   2    7044210.  0.16761   0.    0.    0.   9
0841210   2    7039580.  0.25524   0.    0.    0.  10
0521201   2    7036070.  0.669336  0.    0.    0.   1
0521202   2    7002170.  0.29212   0.    0.    0.   2
0111201   2    7002930.  0.54092   0.    0.    0.   1
0121201   2    7002880.  0.52087   0.    0.    0.   1
0121202   2    7001350.  0.51525   0.    0.    0.   2
0211201   2    7003220.  0.64077   0.    0.    0.   1
0211202   2    7003950.  0.64018   0.    0.    0.   2

0211203   3    7000840.  558.91    0.    0.    0.   3
0211204   3    7011500.  541.94    0.    0.    0.   4
0711201   3    7010000.  541.83    0.    0.    0.   8
0761201   3    7120000.  541.75    0.    0.    0.   5
0861201   3    7063530.  545.99    0.    0.    0.   1
0861202   3    7053260.  553.69    0.    0.    0.   2
0861203   3    7043580.  558.02    0.    0.    0.   3
0971201   3    7116000.  541.65    0.    0.    0.   3
*
*   JUNCTION INITIAL VALUES
0861300    0
0861301   1.198      1.302     0.    1    1.319     1.781     0.    2
0861302   1.699      3.817     0.    3    2.006     5.219     0.    4
0861303   2.278      6.435     0.    5    2.512     7.934     0.    6
0861304   2.862      8.305     0.    7    3.091     8.787     0.    8
0861305   4.251      9.297     0.    9
0521300   1
0521301   4.35       1.76      0.   1
0121300   1
0121301  -7.12       1.76      0.   1
0211300   1
0211301   11.47      0.        0.   3
0711300   1
0711301   13.96      0.    0.    7
0761300   1
0761301   6.56       0.    0.    4
0861300   1
0861301   0.60       0.    0.   2
0971300   1
0971301   1.55       0.    0.     2
*
*   **** CHANGE CARDS TO SET CORE PRESSURE DROP ***
0860P01   1.E-4 0.0134  10
0520901   1.70   1.70   1
1030101   033010000 0840000000 0.000473   0.340      0.200      0000
```

52

```
*        INPUT FOR RELAP5/MOD2
*        FIA-II SPLIT BREAK TRANSIENT / STEADY STATE TO S S
*        100 S/D POWER BEAM CORE CHANNEL
0000100  RESTART  TRANSNT
0000101  RUN
0000103  001
0000105  10.        20.
0000201  5.0  1.0E-6    0.05       00002     5   100   100
0000203  80.  1.0E-6    0.2        00002     1    50    50
*
0000502  TIME      0           LT   NULL 0    0.     L
0000503  TIME      0           LT   NULL 0    0.     L
0000504  TIME      0           GE   NULL 0    5.     L
*
*
*
0130000  VOL13     SNGLVOL
0130101  0.    3.854e     0.01831   0.   0.   0.        0.   0.        00
0130200  2     7000700.     1.
************************
*
1100000  JUN12-13  SNGLJUN
1100101  012010000 013000000 0.001432  0.95       0.95       0000
1100201  1         0.        0.        0.
************************
*
1170000  BY-PASS   VALVE
1170101  030610000 0A4000000 0.000501  0.         0.         0000
1170201  1         0.00      0.        0.
1170300  MINVLV    *    CONSTANT AREA DURING THE TRANSIENT
1170301  0000503   0000502   0.02      0.1788
1170400  1.0  36.28
1170401  .000 .000 .000 .125 .0986 .0986 .208 .1301 .1301
1170402  .500 .1955 .1955 1.00 .2837 .2837
************************
*
3040000  RELIEF    THDPVOL
3040101  0.00836   1.   0.   0.   0.   0.   0.        00
3040200  2
3040201  0.        100000.   1.0
************************
*
40A1000  RELIEF    THDPJUN
40A1101  013010000 304000000 0.00009400
40A1200  1   0   CNTRLVAR   100
40A1201  0.   0.   0.   0.
40A1202  1.E6 0.   1.E6 0.
************************
*
*
2010000  PUMP1     PUMP
2010101  0.        0.750     0.01010   0.   10.4 0.283     0
2010108  073010000    0.00427    0.17       0.37       0000
2010179  074000000    0.0000900  3.00       1.00       0000
2010200  3    7.1126e+06    541.74
2010201  1    4.56   0.   0.
2010202  1    4.56   0.   0.
```

```
2010301  0    0    0   -1   0    0    0
2010302  303.69    0.7552e+   0.0381    50.   81.7    1.   1000.
2010303  0.   0.   0.   0.   0.
* NYA HOMOLOGA PUMPKURVOR. DATA HÄMMER FRÅN ASEA-ATOMS GÖBLIN-BER.
*  TORQUE-KURVORNA SAKNAR BETYDELSE I DETTA FALL OCH HAR DÄRFÖR INTE
* KONTROLLERATS, RÄKNAR FÖR EN DEL DATA ÄR OKÄND.
2011100    1    1
2011101    0.00+1.101      0.27+1.100      0.47+1.100
2011102    0.64+1.138      1.00+1.000
2011200    2    1
2011201    0.00+0.84       0.69+0.87       0.19+0.89
2011202    0.38+0.92       0.59+0.962      0.80+0.99       1.00+1.00
2011300    1    2
2011301    0.0+-0.568      0.41+-0.16      0.51+-0.05      0.76+0.48
2011302    1.00+1.00
2011400    2    2
2011401    0.0+-1.16       0.9+0.88        0.88+0.38       1.00+1.00
2011500    1    3
2011501    -1.00+2.00      -0.95+1.81      -0.62+1.52      -0.50+1.39
2011502      0.00+1.18
2011600    1    4
2011601    -1.00+2.00      -0.79+1.53      -0.63+1.25      -0.30+0.93
2011602      0.00+0.72
2011700    2    3
2011701    -1.00+3.31      -0.83+2.78      -0.68+2.29      -0.56+1.95
2011702    -0.37+1.49      -0.22+1.19      -0.10+0.99      0.00+0.84
2011800    2    4
2011801    -1.00+3.31      -0.79+2.78      -0.59+2.37      -0.41+2.04
2011802    -0.21+1.78      0.00+1.55
* TWO PHASE MULTIPLIER TABLES
2013000    8
2013001  0.0+0.0  0.1+0.0  0.15+0.05  0.24+0.8  0.3+0.96  0.4+0.98
2013002  0.6+0.97  0.8+0.9  0.9+0.8  0.96+0.5  1.0+0.0
2013100    8
2013101  0.0+0.0  0.1+0.0  0.15+0.05  0.24+0.8  0.3+0.96  0.4+0.98
2013102  0.6+0.97  0.8+0.9  0.9+0.8  0.96+.5  1.0+0.0
* TWO PHASE DIFFERENCE FOR PUMP HEAD (SEMISCALE)
2014100    1    1
2014101  0.0+0.0  0.1+0.87  0.2+1.09  0.4+1.02  0.7+1.01  0.9+0.94  1.0+1.0
2014200    1    2
2014201  0.0+0.0  0.1+-0.04  0.2+0.0  0.3+0.1  0.4+0.23  0.8+0.0 67
2014202  0.9+0.80  1.0+1.0
2014300    1    3
2014301  -1.0+-1.16  -0.9+-1.24  -0.8+-1.77  -0.7+-2.36  -0.6+-2.79
2014302  -0.5+-2.91  -0.4+-2.67  -0.25+-1.89  -0.1+-0.5  0.0+0.0
2014400    1    4
2014401  -1.0+-1.16  -0.9+-0.78  -0.8+-0.5  -0.7+-0.31  -0.6+-0.17
2014402  -0.5+-0.08  -0.3%.0.0  -0.2+0.05  -0.1+0.08  0.0+0.11
* TWO PHASE DIFFERENCE FOR PUMP TORQUE I= SINGLE PHASE. WHICH MEANS
* THAT FULLY DEGRADED TORQUE IS ZERO)
2014500    2    1
2014501  0.00+0.84       0.69+0.87       0.19+0.89
2014502  0.38+0.92       0.59+0.962      0.80+0.99       1.00+1.00
2015000    2    2
2015001  0.0+-1.16       0.9+0.88        0.88+0.38       1.00+1.00
2015100    2    3
2015101    -1.00+3.31      -0.83+2.78      -0.68+2.29      -0.56+1.95
```

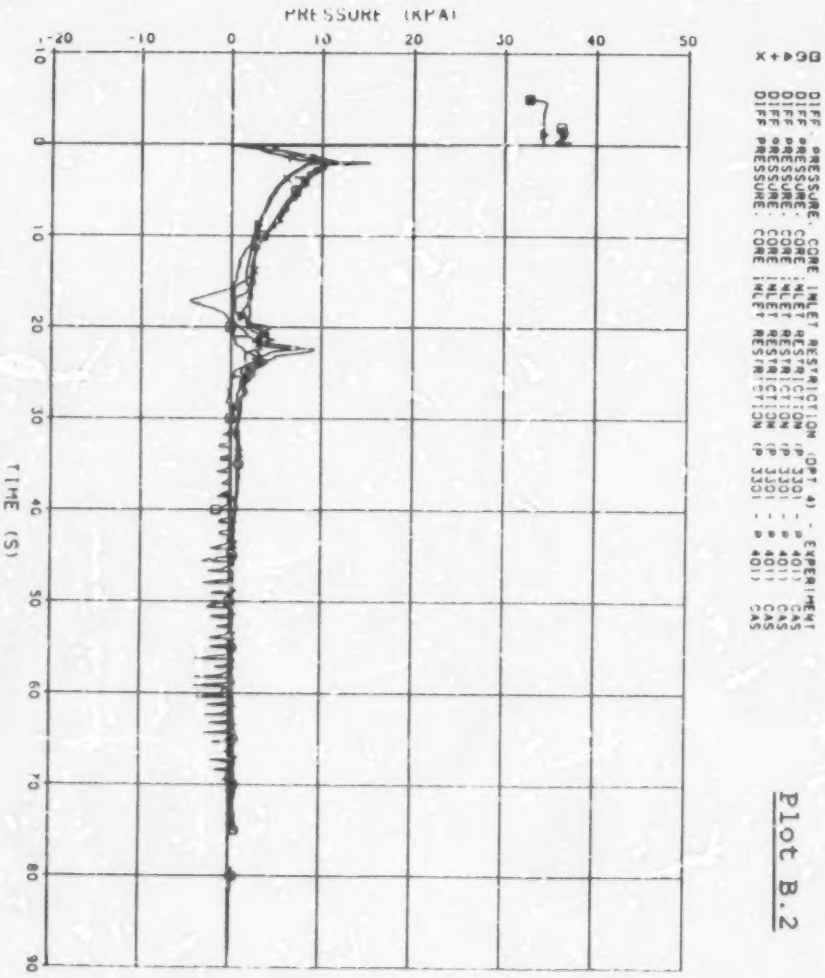
```
2015102    -0.37+1.49      -0.22+1.19      -0.10+0.99      0.00+0.84
2015200    2    4
2015201    -1.00+3.31      -0.79+2.78      -0.59+..37      -0.41+2.04
2015202    -0.21+1.78      0.00+1.55
** PUMP1 SPEED
2016100    504
2016101      0.00        184.11      0.94        159.68
2016102      2.00        144.09      4.71        124.78      10.00       97.31
2016103     15.00         79.38     17.44         55.24      20.44       45.27
2016104     37.86         37.49     48.55         34.29      53.00       29.57
2016105    100.0         29.57
*
************************
*
2020000  PUMP2     PUMP
2020101  0.        0.750     0.009588  0.   72.0 0.228     0
2020105  004010000    0.0019    0.35       0.35       0000
2020106  005000000    0.000300  3.00       3.00       0000
2020200  3   7.1052?E+06    561.46
2020201  1    1.55 0.   0.
2020202  1    1.55 0.   0.
2020*01  0    0    -1   -1   0    0
2020302  303.69    0.7552e+  0.01056   25.       13.2      1.        1000.
2020303  0.   0.   0.   0.   0.
2021100    1    1
2021101  0.0   1.136     0.2   1.135     0.6   1.122
2021102  0.6   1.100     0.8   1.055     1.0   1.000
2021200    2    1
2021201  0.0   0.51      1.0   1.00
2021300    1    2
2021301  0.0 -0.560      0.2 -0.385      0.6 -0.100      0.5 -0.055
2021302  0.6   0.165     0.8   0.565     1.0   1.000
2021400    2    2
2021401  0.0 -0.67       0.2 -0.21       0.4   0.07
2021402  0.6   0.35      0.8   0.66      1.0   1.00
2021500    1    3
2021501    -1.00+2.00      -0.95+1.81      -0.62+1.52      -0.50+1.39
2021502      0.00+1.176
2021600    1    4
2021601    -1.00+2.00      -0.79+1.53      -0.63+1.25      -0.30+0.93
2021602      0.00+0.72
2021700    2    3
2021701    -1.00+3.31      -0.83+2.78      -0.68+2.29      -0.56+1.95
2021702    -0.37+1.49      -0.22+1.19      -0.10+0.99      0.00+0.91
2021800    2    4
2021801    -1.00+3.31      -0.79+2.78      -0.59+2.37      -0.41+2.04
2021802    -0.21+1.78      0.00+1.55
2023000    8
2023001  0.0 0.00  0.1 0.00  0.2 0.05  0.3 0.00  0.4 0.96  0.5 0.96
2023002  0.6 0.97  0.7 0.00  0.8 0.00  0.9 0.50  1.0 0.00
2023100    8
2023101  0.0 0.00  0.1 0.10  0.2 0.15  0.3 0.24  0.4 0.36  0.5 0.40
2023102  0.6 0.60  0.7 0.00  0.8 0.90  0.9 0.96  1.0 1.00
** PUMP2 SPEED
2026100    8
2026101    0.0  771.96
************************
```

BEST COPY AVAILABLE

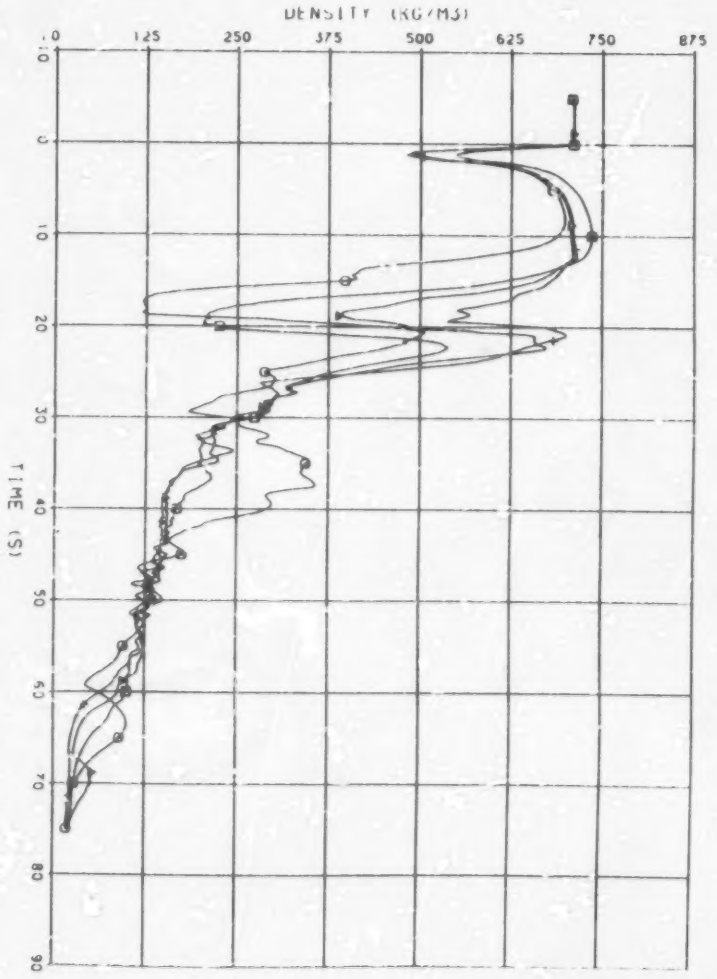
```
*
*STEAM RELIEF FLOW MODEL
20509200   RHOP    MULT    1.    0.    0
20509301   RHOG    813010000   P   813010000
*
20509400   SQRT    POWERR    1.    0.    0
20509401   CNTRLVAR    093   0.5
*
20209300   NORMAREA
20209301   0.      0.      0.4     0.      1.0     1.
20209302   1.00    1.      2.39    0.      12.05   0.
20209303   12.65   1.
*
20509500   TBREAK    TRIPDLAY  1.    0.    0
20509501   504
*
20509600   "T-TBREAK"    SUM    1.    0.    0
20509601    0.     1.     TIME    0
20509602          -1.     CNTRLVAR   095
*
20509700    TRPTEST     TRIPUNIT    1.    0.    0
20509701   504
*
20509800    ATIME     MULT    1.    0.  0
20509801    CNTRLVAR    096
20509802    CNTRLVAR    097
*
20509900   VLVAREA    FUNCTION    1.0340E-4    0.    0
20509901   CNTRLVAR    098       093
*
20510000   MSSFLOW    MULT    0.6636   0.    0
20510001   CNTRLVAR    099    CNTRLVAR    096
*
*
20500100   MASSDIFF1    DELETE
20500200   INTEGRAL1    DELETE
20500300   VELDIFF1     DELETE
20500400   MASSDIFF2    DELETE
20500500   INTEGRAL2    DELETE
20500600   VELDIFF2     DELETE
*
3050000   LEVCTRVOL     DELETE
4050000   LEVCTRJUN     DELETE
20504900   LEVCTR        DELETE
*
. END
```

BEST COPY AVAILABLE

RELAP5/MOD2 CALCULATION FOR FIX-II. EXP 3027



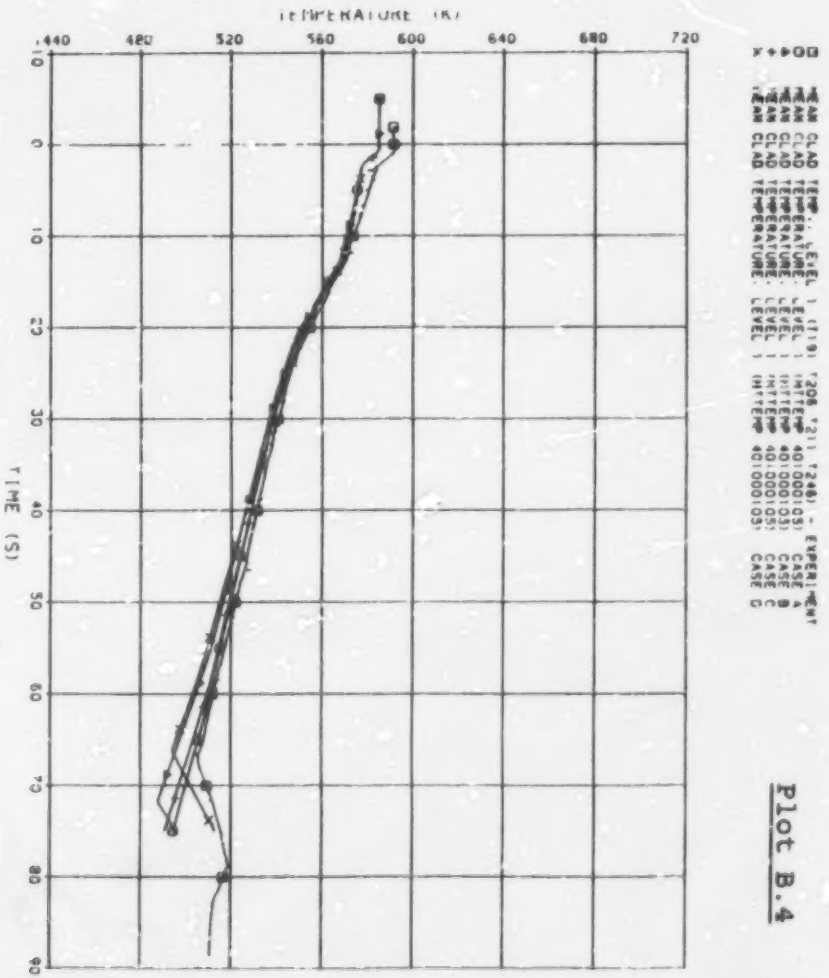
Plot B.2



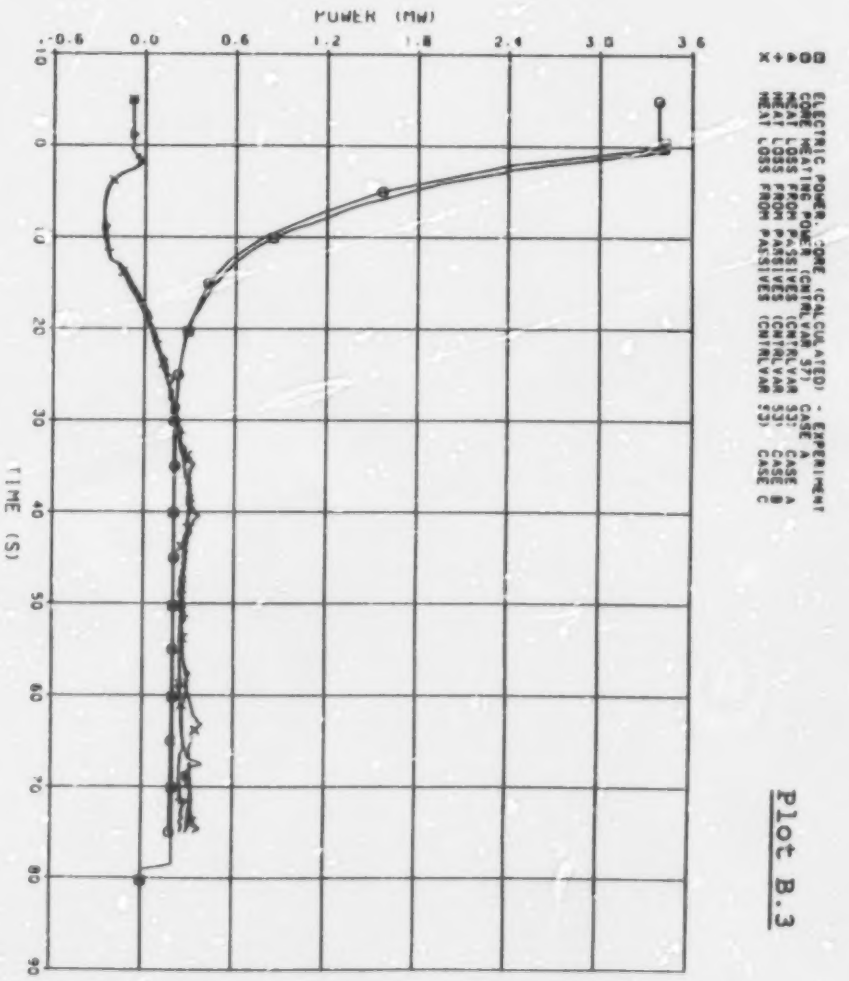
Plot B.1

BEST COPY AVAILABLE

RELAP5/MOD2 CALCULATION FOR FIX-II. EXP 3027



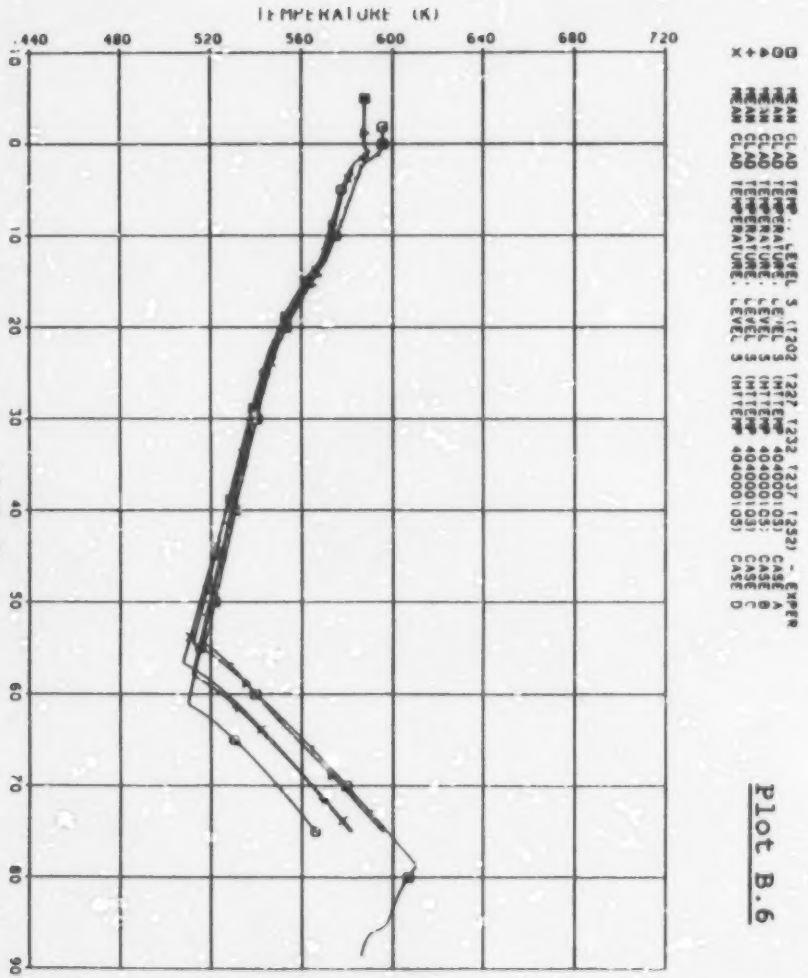
Plot B.4



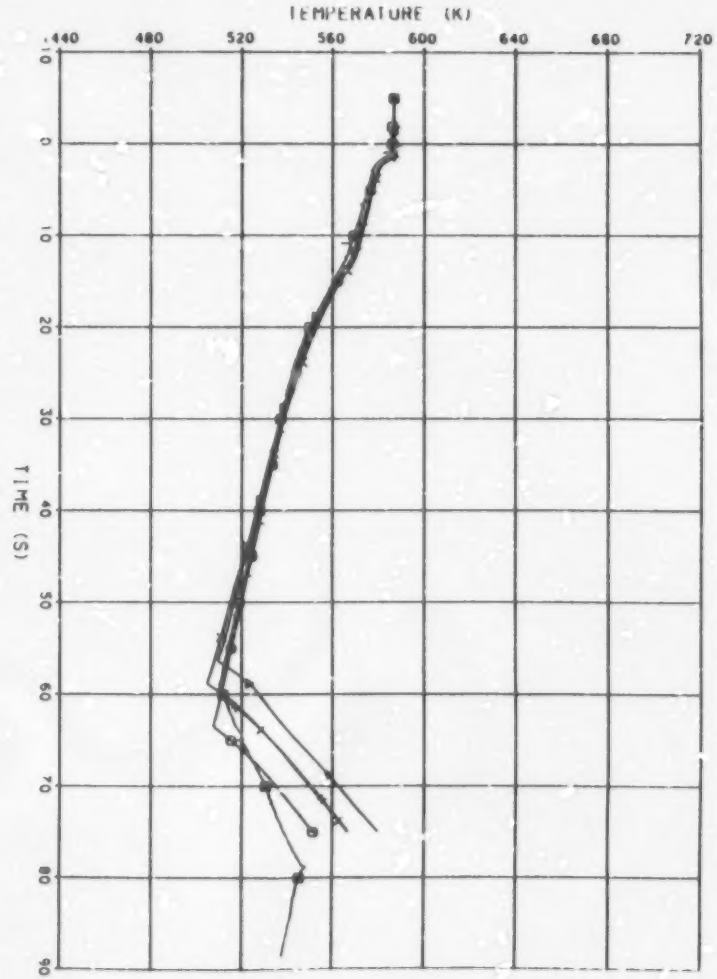
Plot B.3

BEST COPY AVAILABLE

RELAP5/MOD2 CALCULATION FOR FIX-II. EXP 3027



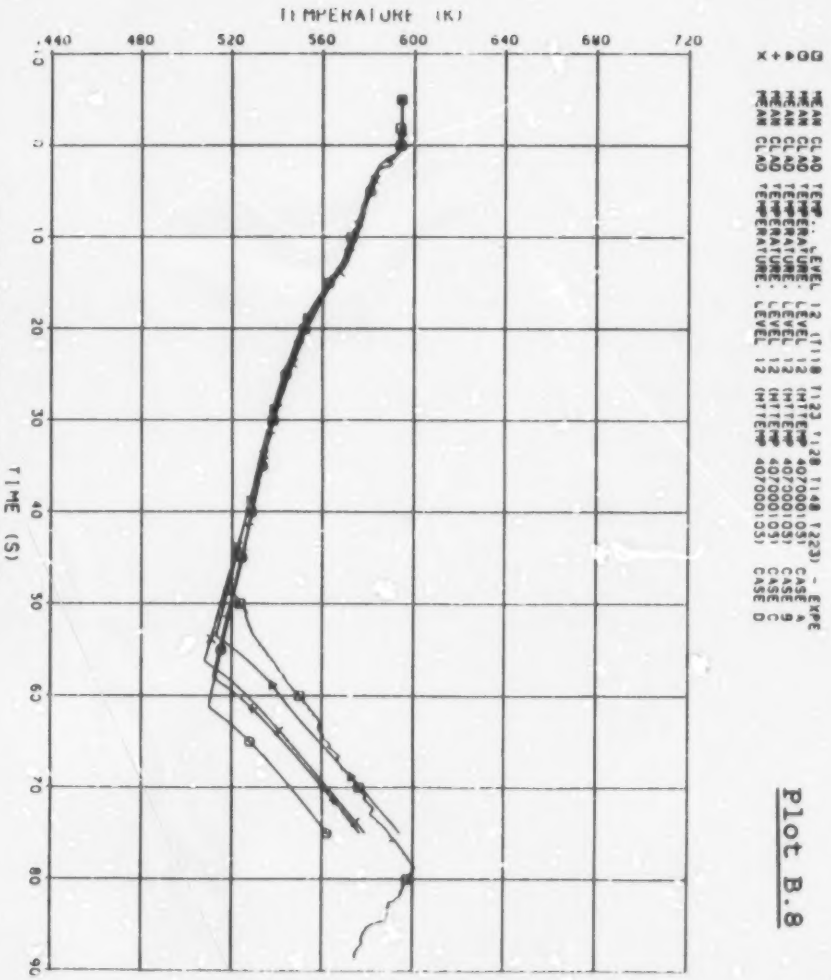
Plot B.6



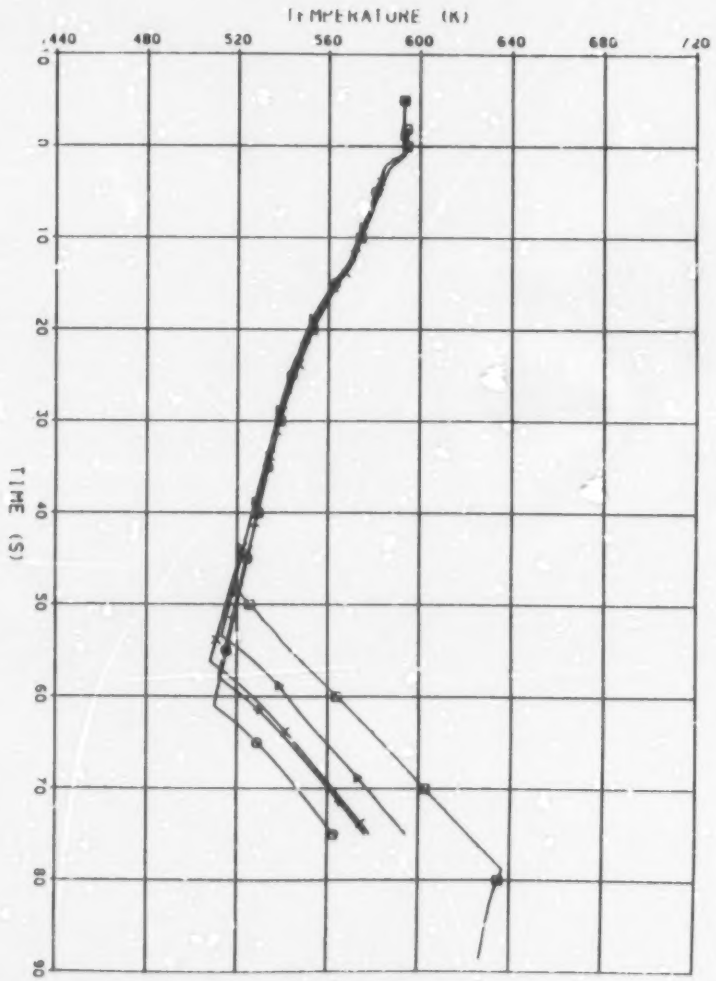
Plot B.5

BEST COPY AVAILABLE

RELAP5/MOD2 CALCULATION FOR FIX-II. EXP 3027



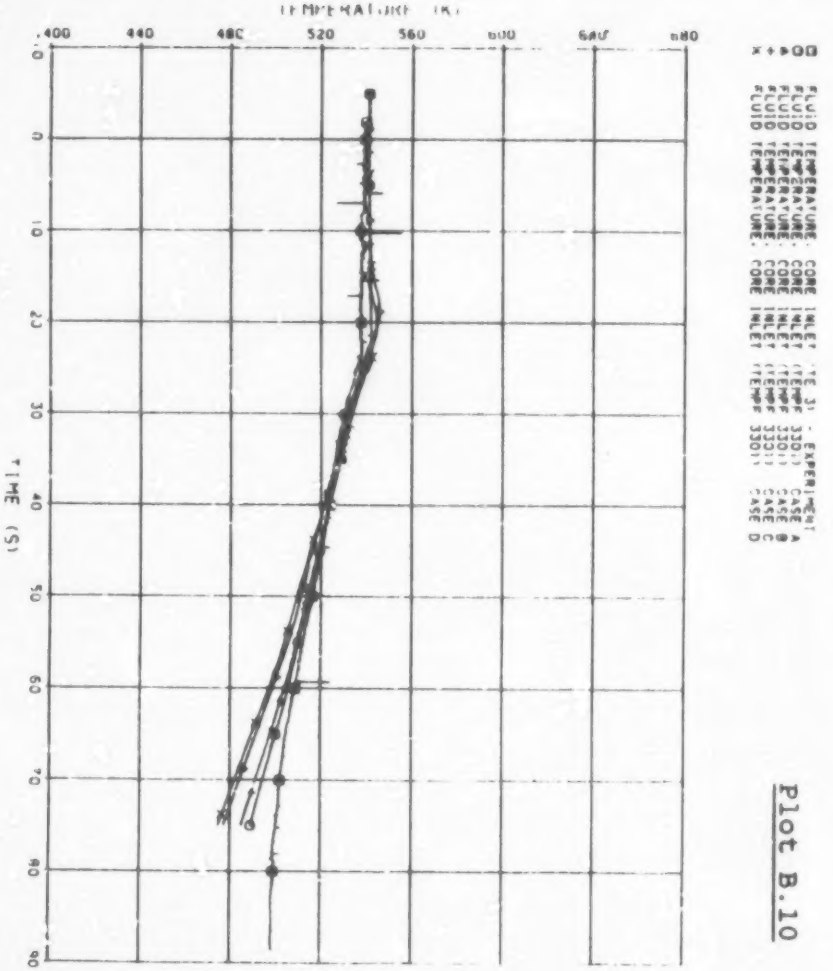
Plot B.8



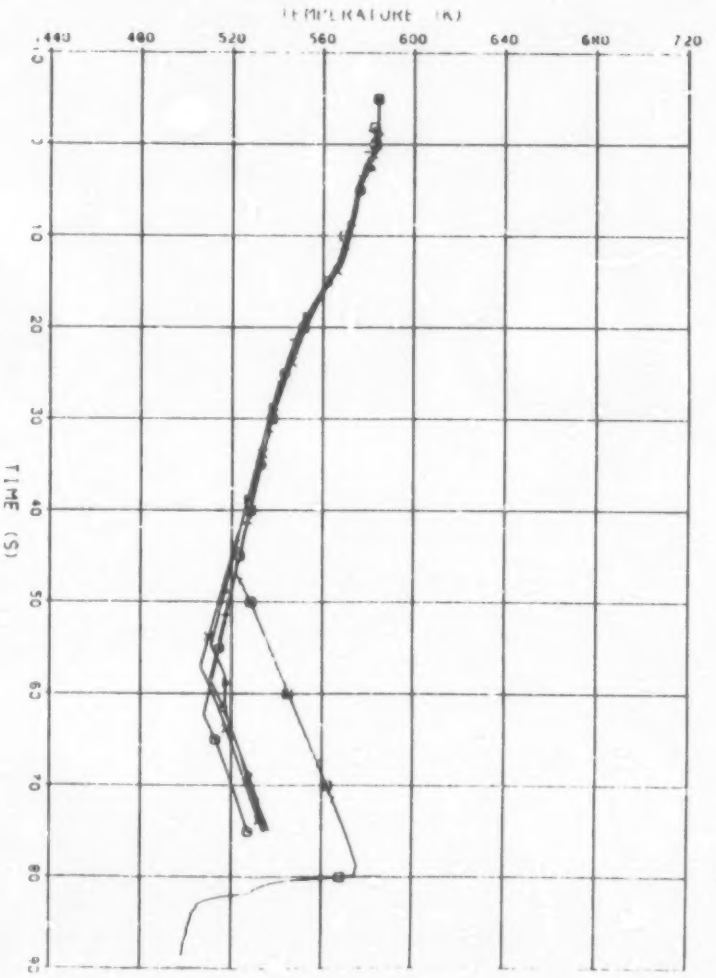
Plot B.7

BEST COPY AVAILABLE

RELAP5/MOD2 CALCULATION FOR FIX-II. EXP 3027



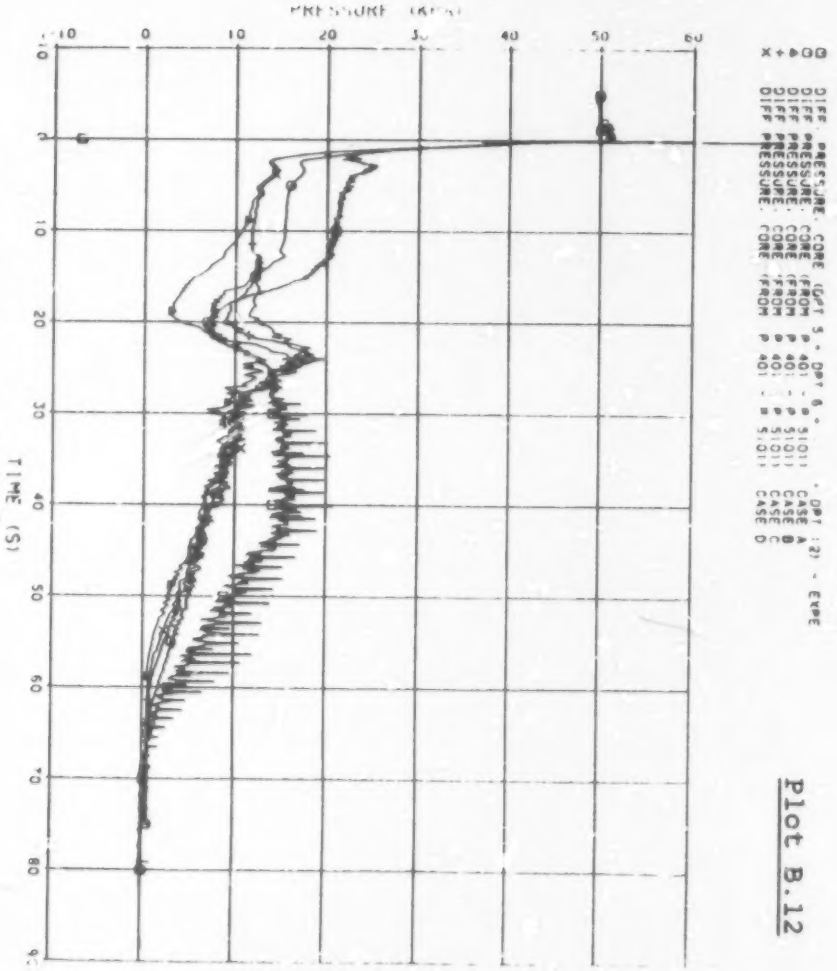
Plot B.10



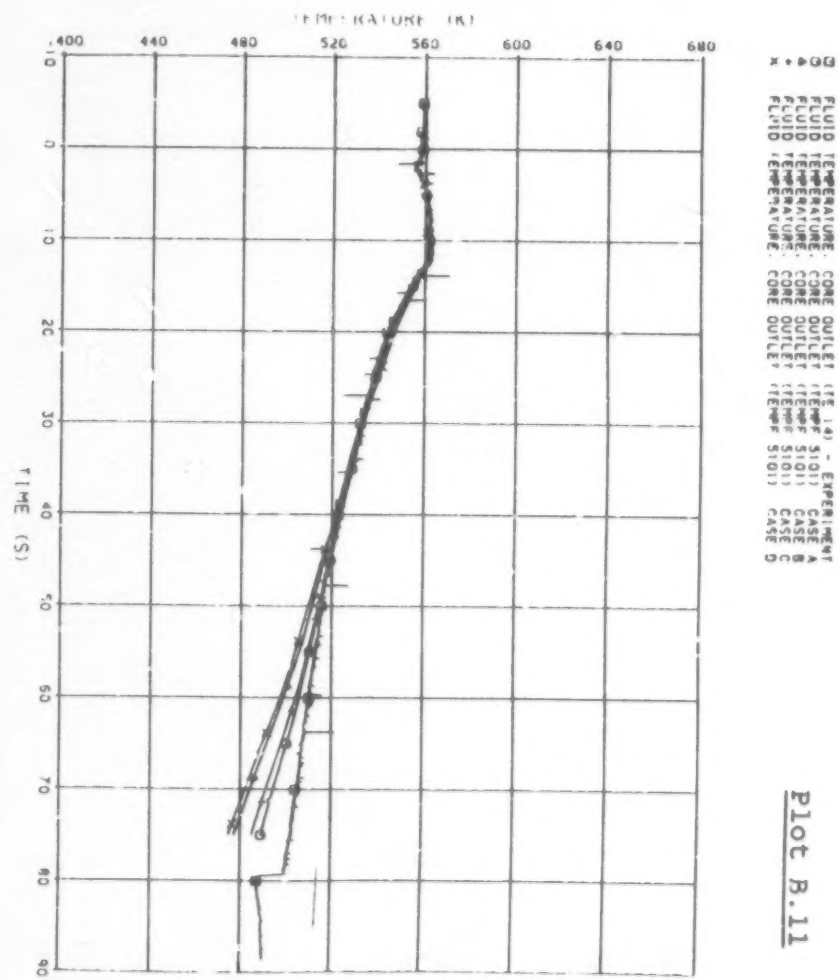
Plot B.9

BEST COPY AVAILABLE

RELAP5/MOD2 CALCULATION FOR FIX-II. EXP 3027



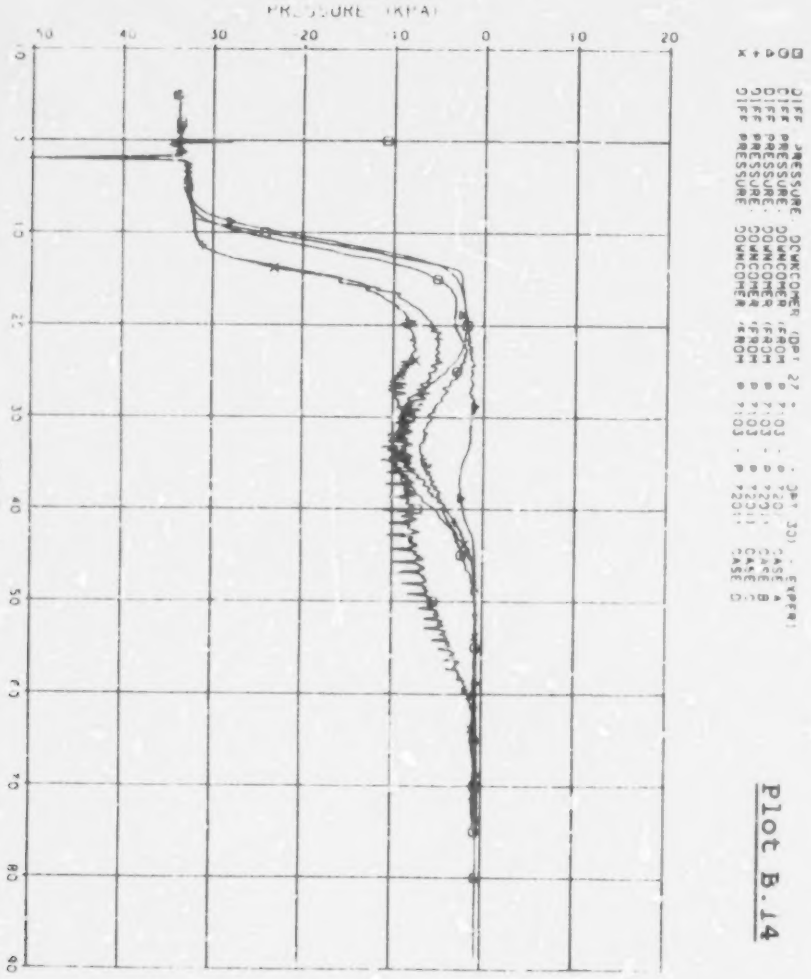
Plot B.12



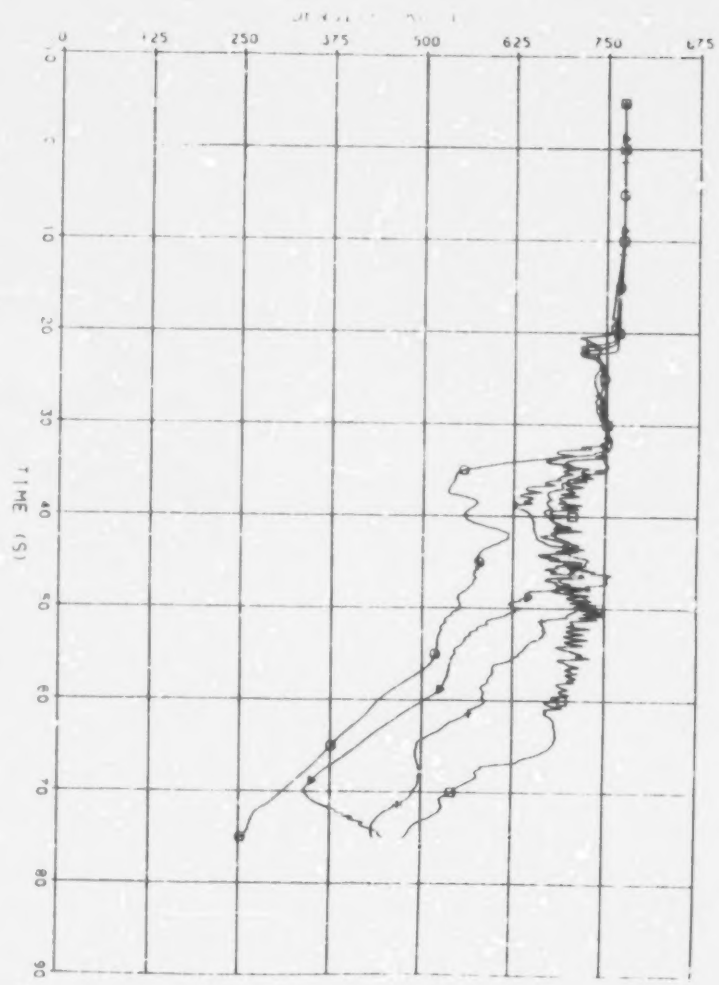
Plot B.11

BEST COPY AVAILABLE

RELAP5/MOD2 CALCULATION FOR FIX-II. EXP 3027


PRESSURE (KPA)
TIME (S)
DIFF PRESSURE DOWNCOMER (DP1 27 - DP1 30) : EXP3027
DIFF PRESSURE DOWNCOMER (FROM 0 TO 3.03) : CASE A
DIFF PRESSURE DOWNCOMER (FROM 0 TO 3.03) : CASE B
DIFF PRESSURE DOWNCOMER (FROM 0 TO 3.03) : CASE C
DIFF PRESSURE DOWNCOMER (FROM 0 TO 3.03) : CASE D

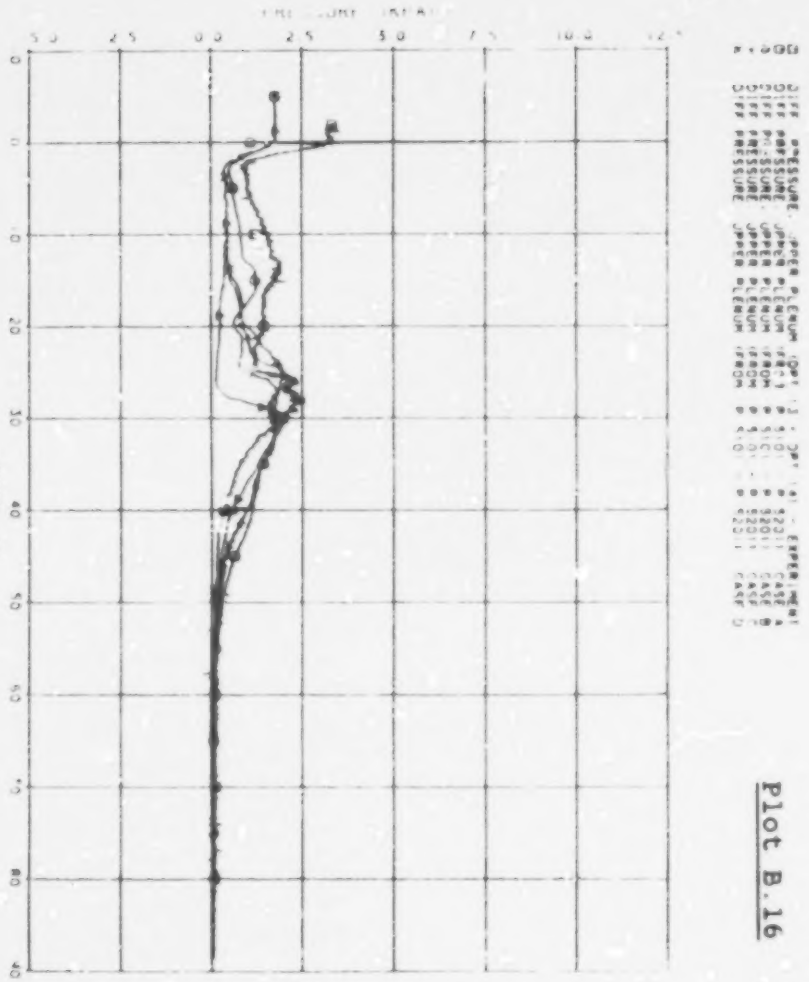
Plot B.14


TIME (S)
FLUID DENSITY: /VESSEL BOTTOM (RHO 3:01) CASE A
FLUID DENSITY: /VESSEL BOTTOM (RHO 3:01) CASE B
FLUID DENSITY: /VESSEL BOTTOM (RHO 3:01) CASE C
FLUID DENSITY: /VESSEL BOTTOM (RHO 3:01) CASE D

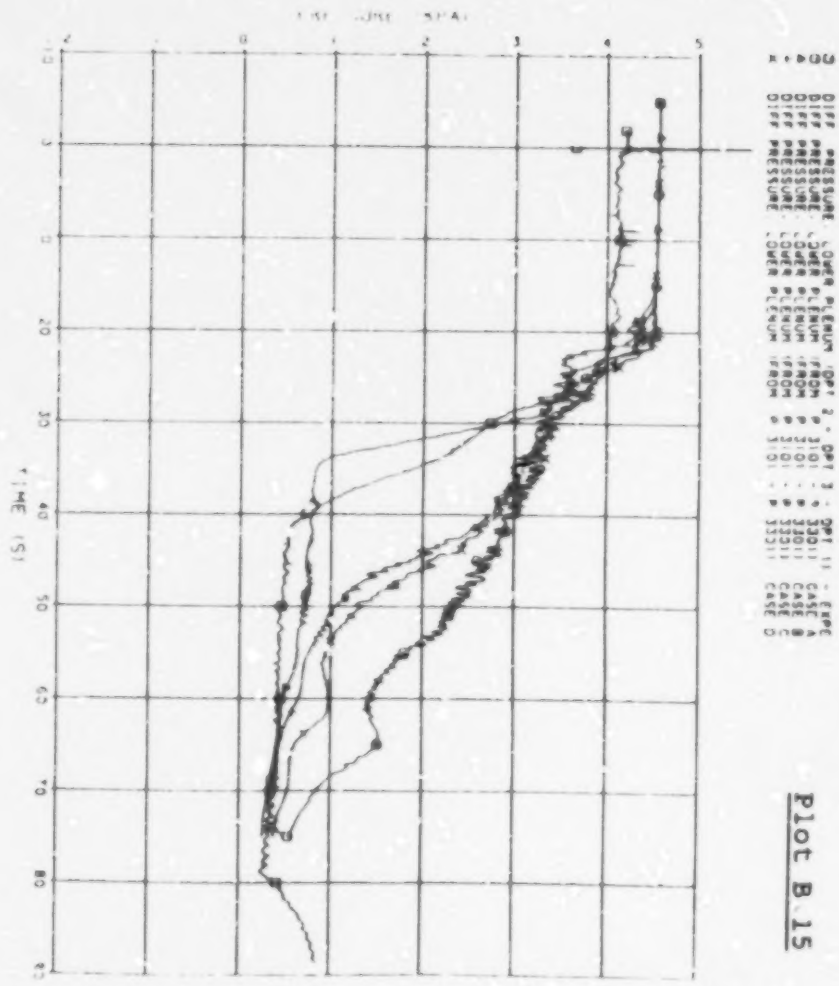
Plot B.13

BEST COPY AVAILABLE

RELAP5/MOD2 CALCULATION FOR FIX-II. EXP 3027



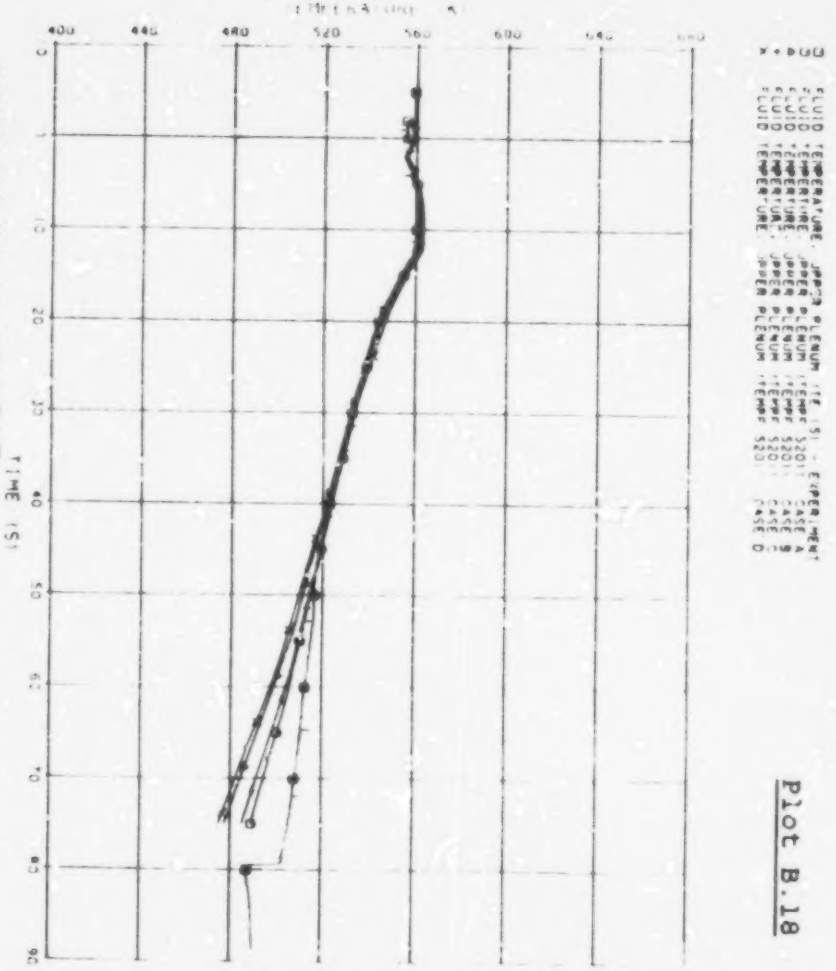
Plot B.16



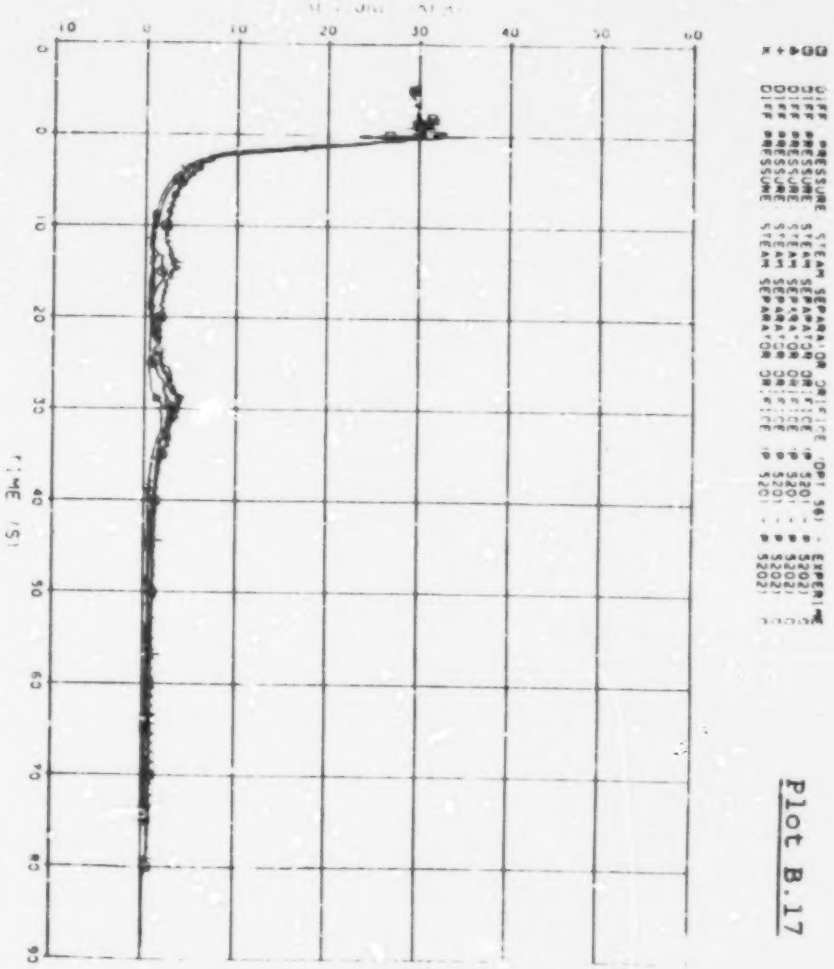
Plot B.15

BEST COPY AVAILABLE

RELAP5/MOD2 CALCULATION FOR FIX-II. EXP 3027



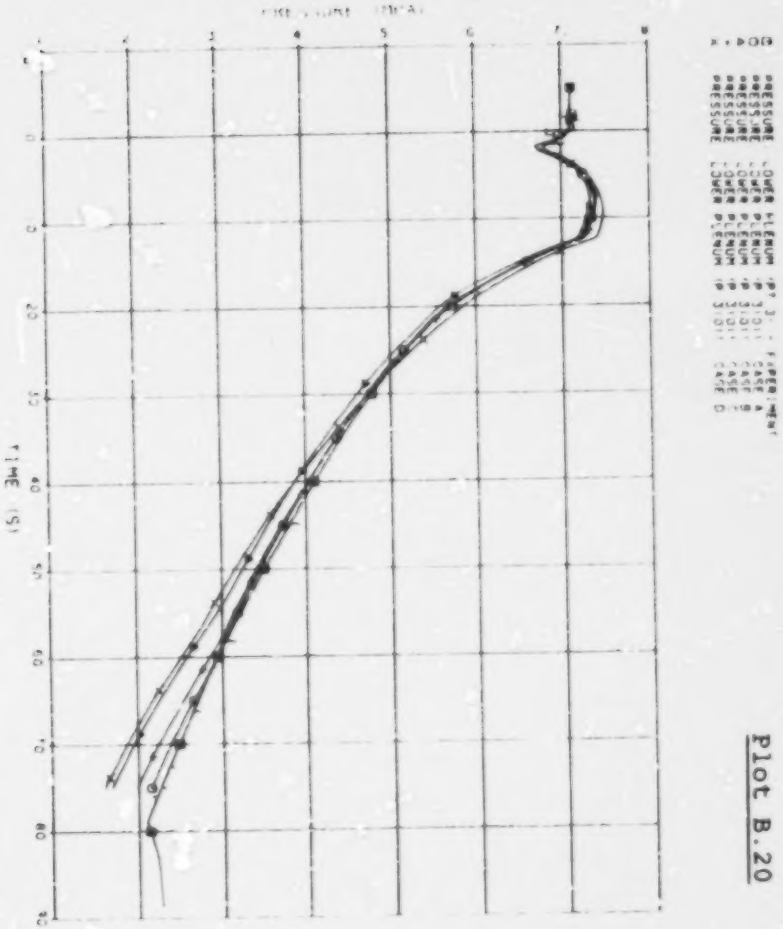
Plot B.18



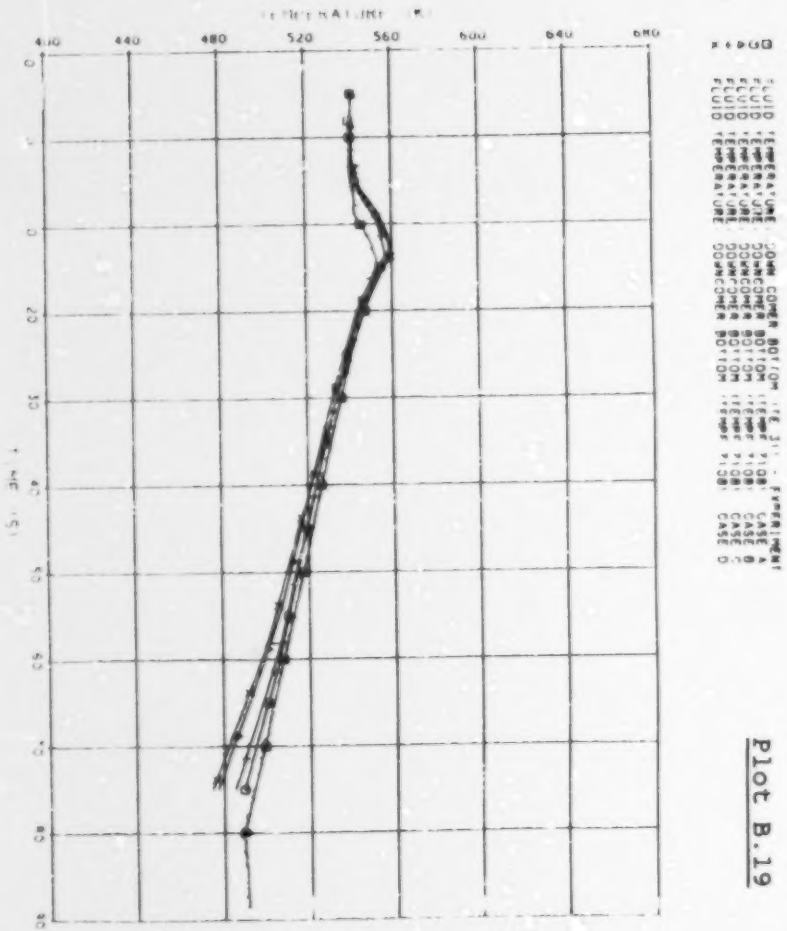
Plot B.17

BEST COPY AVAILABLE

RELAP5/MOD2 CALCULATION FOR FIX-II. EXP 3027



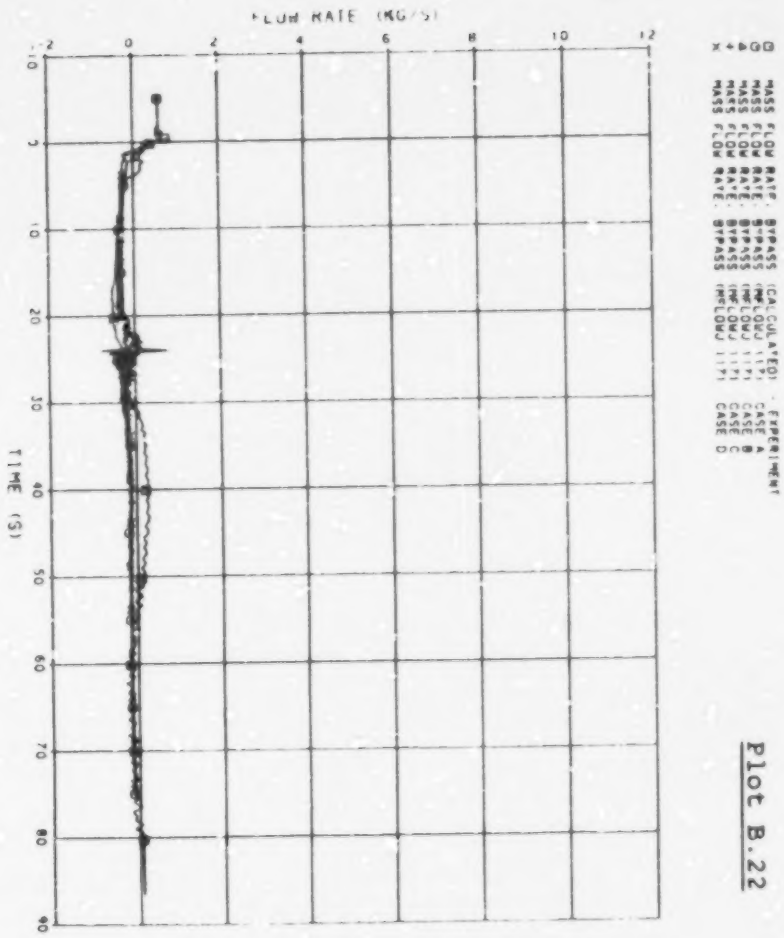
Plot B.20



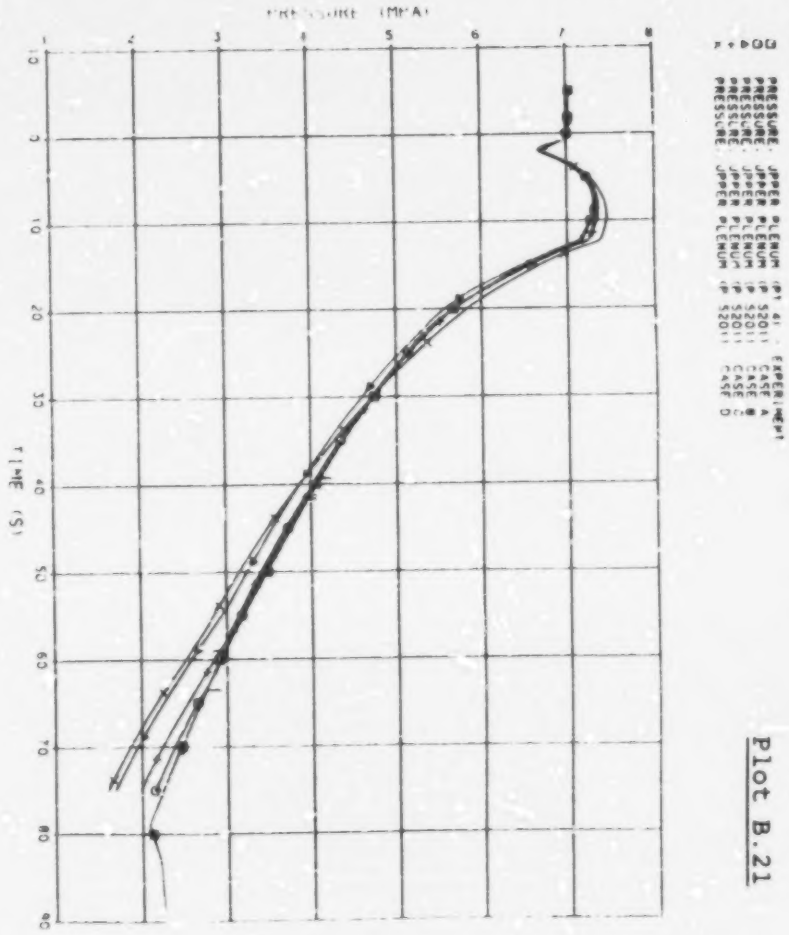
Plot B.19

BEST COPY AVAILABLE

RELAP5/MOD2 CALCULATION FOR FIX-II. EXP 3027



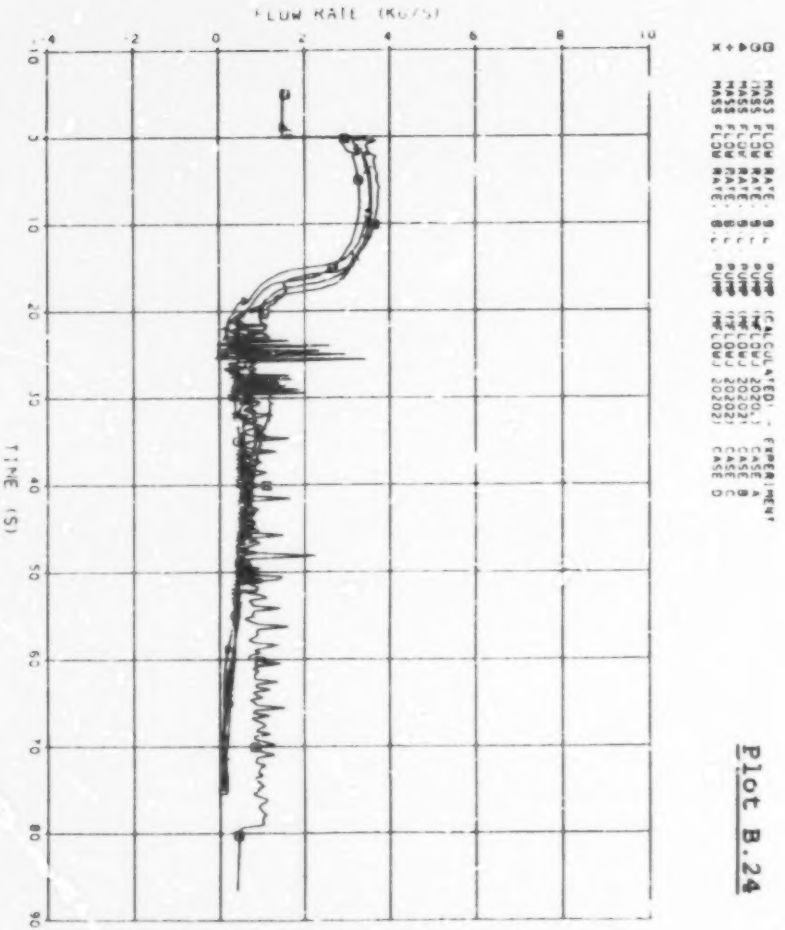
Plot B.22



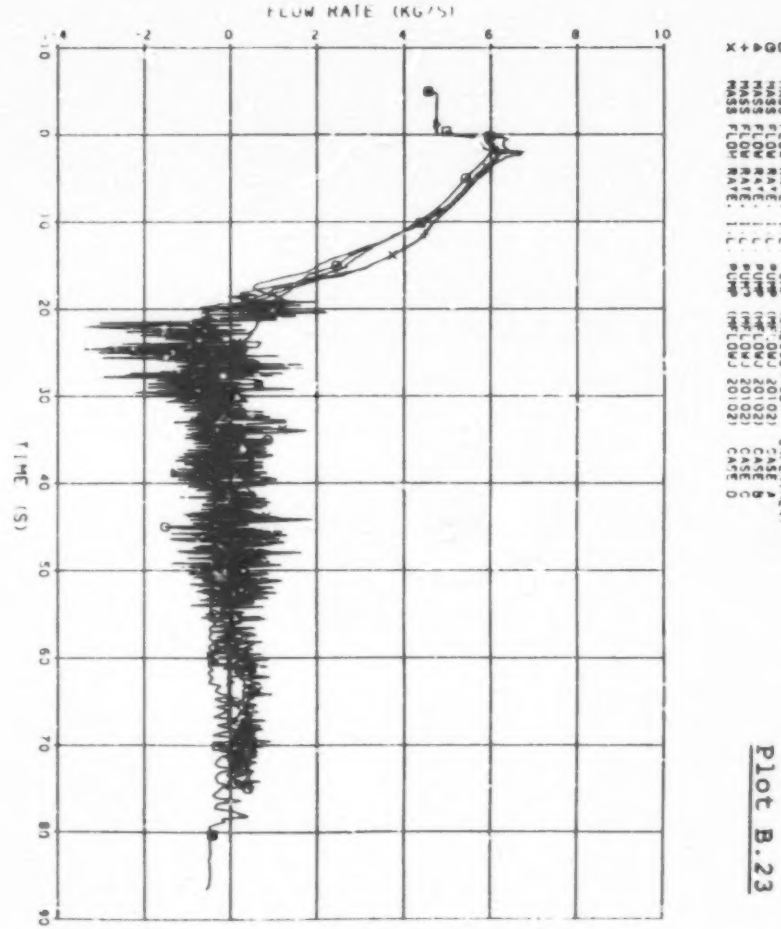
Plot B.21

BEST COPY AVAILABLE

RELAP5/MOD2 CALCULATION FOR FIX-II. EXP 3027


FLOW RATE (KG/S)
TIME (S)
MASS FLOW RATE: PUMP (CALCULATED) - EXPERIMENT
MASS FLOW RATE: PUMP (INFLOW) 201.02) CASE A
MASS FLOW RATE: PUMP (INFLOW) 201.02) CASE B
MASS FLOW RATE: PUMP (INFLOW) 201.02) CASE C
MASS FLOW RATE: PUMP (INFLOW) 201.02) CASE D

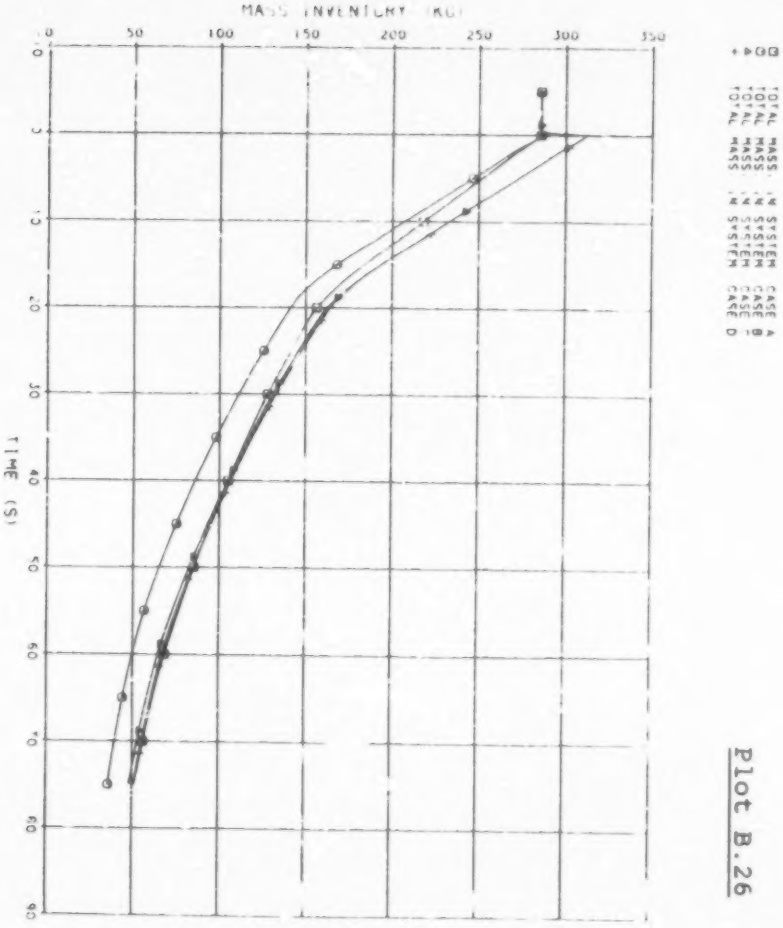
Plot B.24


FLOW RATE (KG/S)
TIME (S)
MASS FLOW RATE: PUMP (CALCULATED) - EXPERIMENT
MASS FLOW RATE: PUMP (INFLOW) 201.02) CASE A
MASS FLOW RATE: PUMP (INFLOW) 201.02) CASE B
MASS FLOW RATE: PUMP (INFLOW) 201.02) CASE C
MASS FLOW RATE: PUMP (INFLOW) 201.02) CASE D

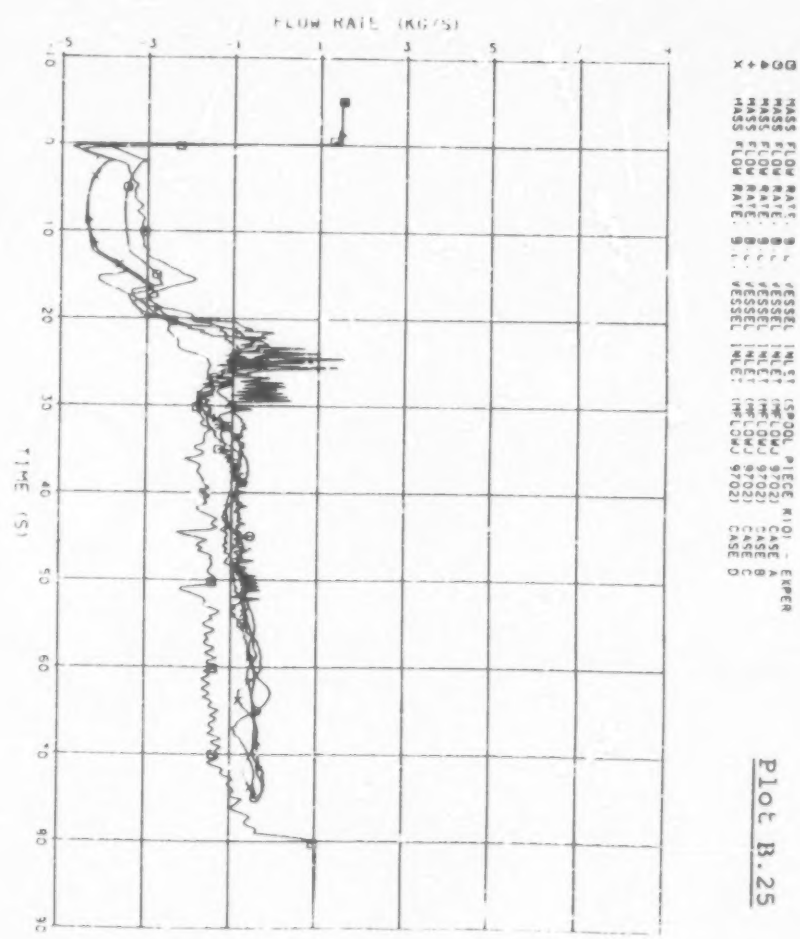
Plot B.23

BEST COPY AVAILABLE

RELAP5/MOD2 CALCULATION FOR F;X-11. EXP 3027



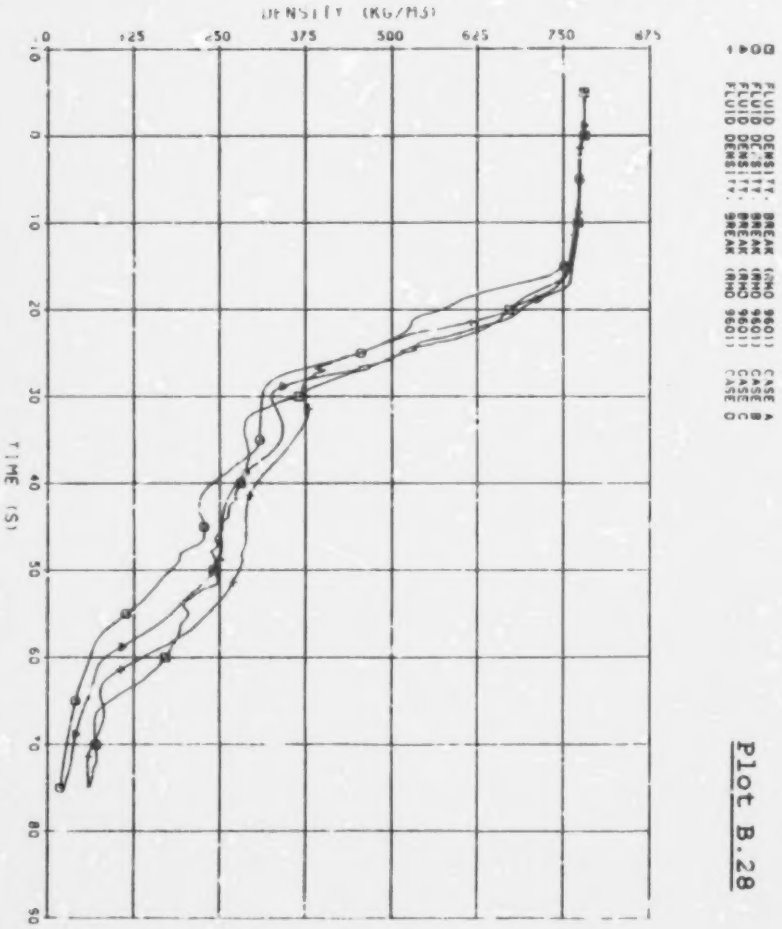
Plot B.26


FLOW RATE (KG/S)
TIME (S)
MASS FLOW RATE: VESSEL INLET (SPOOL PIECE NIOI - EXPER
MASS FLOW RATE: VESSEL INLET (INFLOW) 97021 CASE A
MASS FLOW RATE: VESSEL INLET (INFLOW) 97021 CASE B
MASS FLOW RATE: VESSEL INLET (INFLOW) 97021 CASE C
MASS FLOW RATE: VESSEL INLET (INFLOW) 97021 CASE D

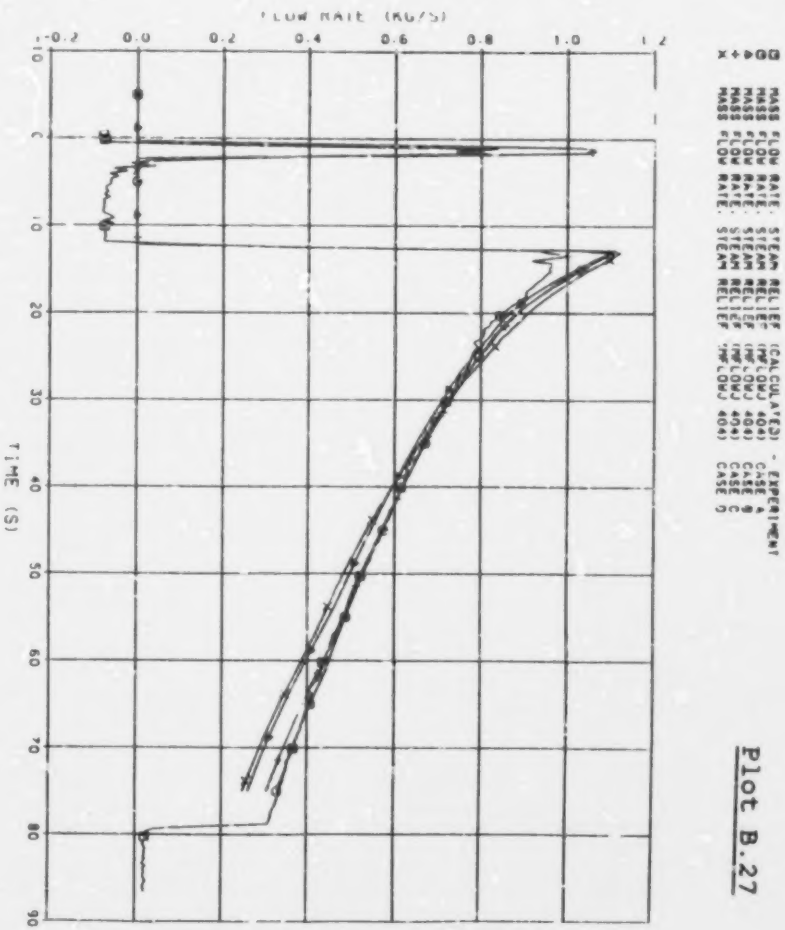
Plot B.25

BEST COPY AVAILABLE

RELAP5/MOD2 CALCULATION FOR FIX-II, EXP 3027


DENSITY (KG/M3)
TIME (S)
FLUID DENSITY, BREAK (MOD 9601) CASE A
FLUID DENSITY, BREAK (MOD 9601) CASE B
FLUID DENSITY, BREAK (MOD 9601) CASE C
FLUID DENSITY, BREAK (MOD 9601) CASE D

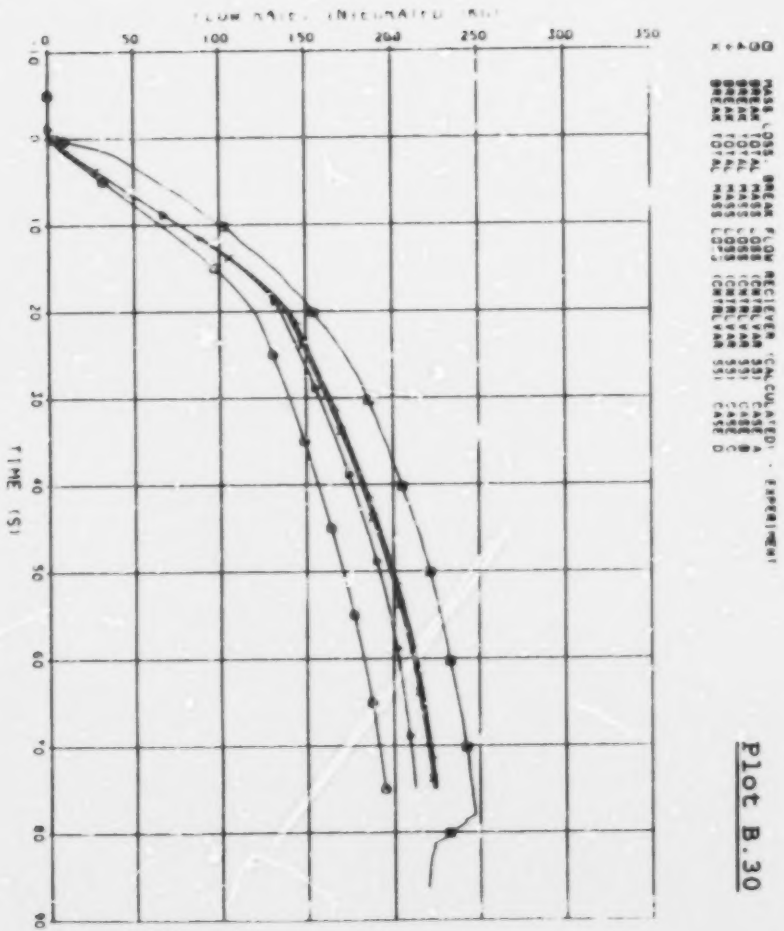
Plot B.28


FLOW RATE (KG/S)
TIME (S)
MASS FLOW RATE, STEAM RELIEF (CALCULATED) - EXPERIMENT
MASS FLOW RATE, STEAM RELIEF (MFLOWJ 404) CASE A
MASS FLOW RATE, STEAM RELIEF (MFLOWJ 404) CASE B
MASS FLOW RATE, STEAM RELIEF (MFLOWJ 404) CASE C
MASS FLOW RATE, STEAM RELIEF (MFLOWJ 404) CASE D

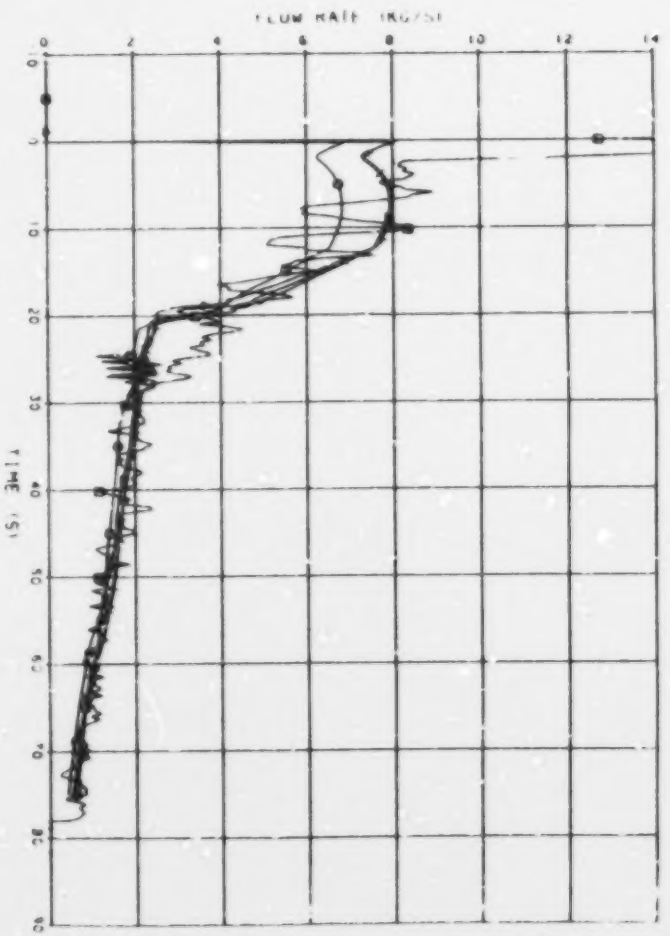
Plot B.27

BEST COPY AVAILABLE

RELAP5/MOD2 CALCULATION FOR FIX-II. EXP 3027



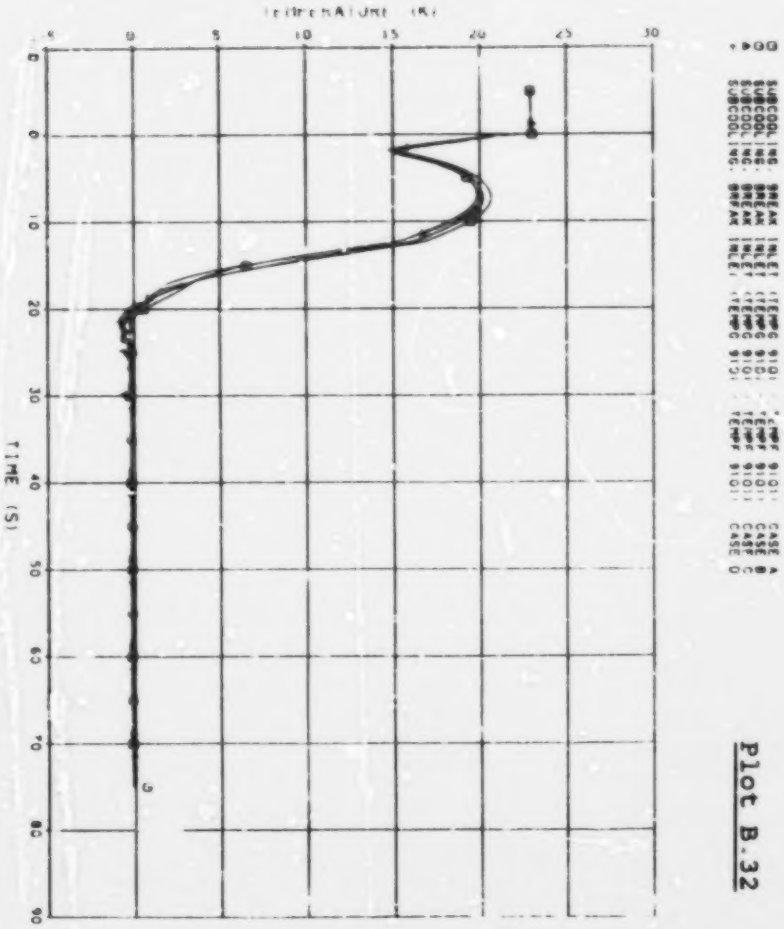
Plot B.30



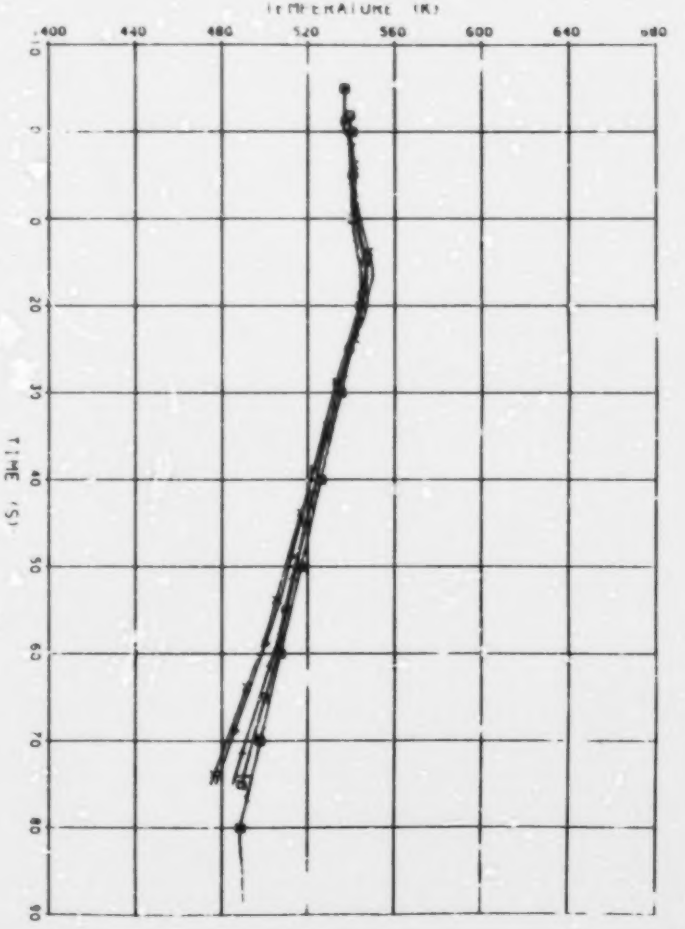
Plot B.29

BEST COPY AVAILABLE

RELAP5/MOD2 CALCULATION FOR FIX-II. EXP 3027



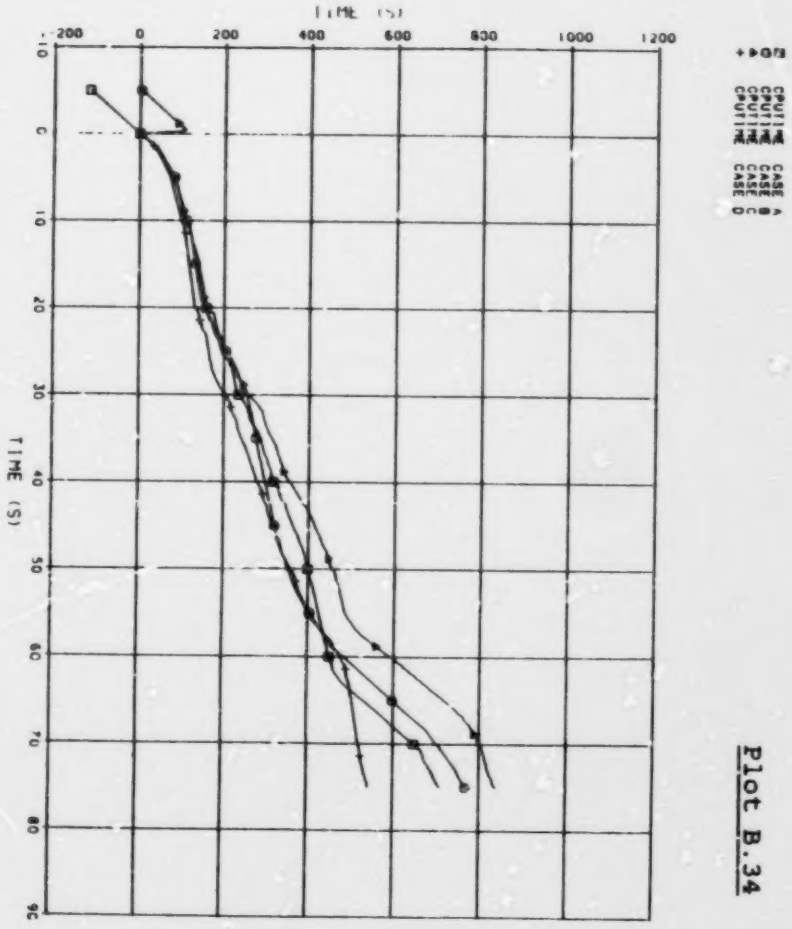
Plot B.32



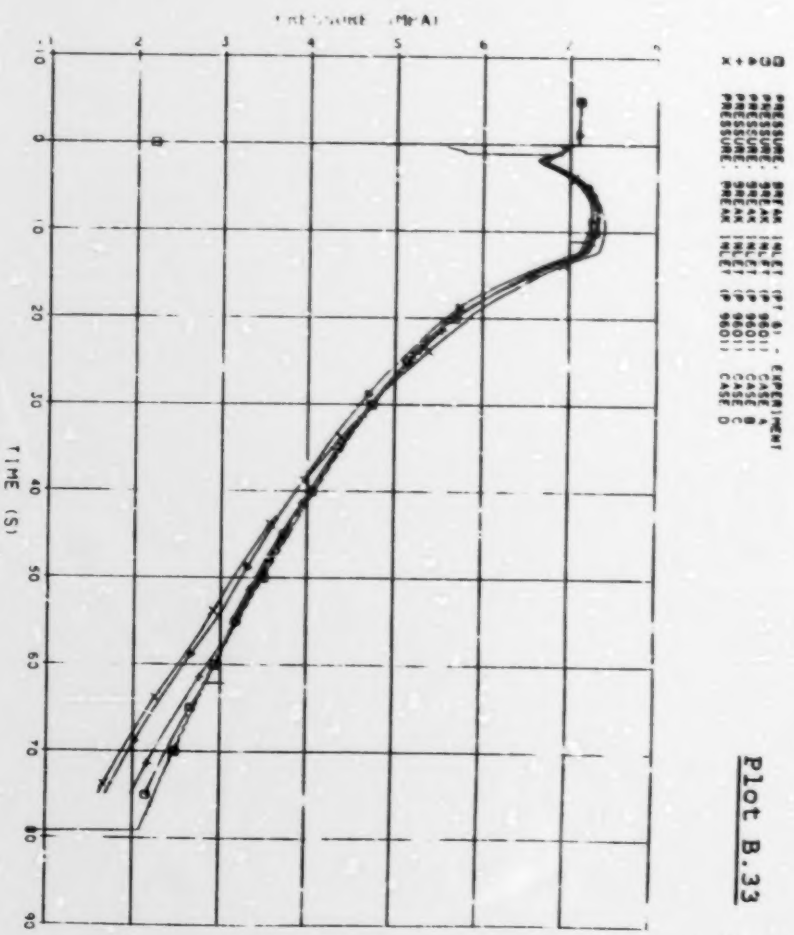
Plot B.31

BEST COPY AVAILABLE

RELAP5/MOD2 CALCULATION FOR FIX-II. EXP 3027



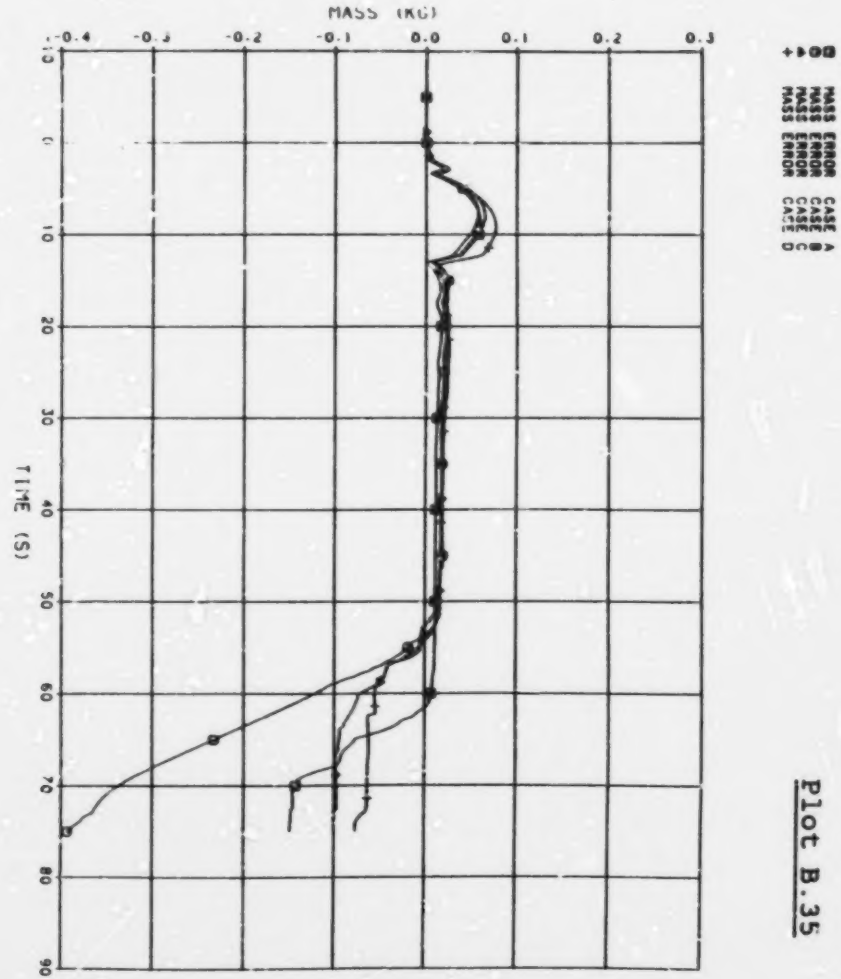
Plot B.34



Plot B.33

BEST COPY AVAILABLE

RELAP5/MOD2 CALCULATION FOR FIX-II. EXP 3027



Plot B.35

BEST COPY AVAILABLE

Calculation to experiment data uncertainty

Case A

CONF CALCULATION-TO-EXPERIMENT DATA UNCERTAINTY ANALYSIS FOR NKG/ICAAP.

FIRST LINE : DIFFERENCE BETWEEN CALCULATED AND (AVERAGED) EXPERIMENTAL DATA AT END OF THE INTERVAL
SECOND LINE : MEAN DIFFERENCE OVER THE INTERVAL
THIRD LINE : MEAN SIGMA OVER THE INTERVAL (ROOT MEAN SQUARE OF THE DIFFERENCE)

- CODES -	- - - - TIME INTERVAL - - - -							
CALC. EXP.	0.0 - 6.000	- 12.00	- 18.00	- 24.00	- 30.00	- 45.00	- 60.00	- 75.00
P 1A - P 3	-.6[illegible]3E-01	.532E-01	.164E-01	.135E-01	-.301E-01	-.622E-01	-.127E-01	-.165
	-.604E-01	.664E-01	.943E-01	-.511E-02	-.241E-01	-.518E-01	-.384E-01	-.621E-01
	.693E-01	.321E-01	.91[illegible]E-01	.154E-01	.311E-01	.525E-	.429E-01	.724E-01
P 2A - P 4	-.281E-01	.842E-01	.[illegible]3[illegible]E-01	.384E-01	-.129E-01	-.338E-01	.119E-01	-.866E-01
	-.234E-01	.40AE-01	.[illegible]88E-01	.207E-01	-.167E-02	-.240E-01	-.158E-01	-.450E-01
	.225E-01	.514E-01	.92[illegible]E-01	.231E-01	.161E-01	.260E-01	.224E-01	.585E-01
P 3A - P 4	-.340E-01	.646E-01	.[illegible]83E-01	.372E-01	-.650E-02	-.546E-01	.780E-02	-.102
	.255	.112E-01	.656E-01	.197E-01	.349E-02	-.296E-01	-.198E-01	-.511E-01
	.772	.323E-01	.71[illegible]E-01	.300E-01	.260E-01	.328E-01	.278E-01	.644E-01
PDA7 - D 6	-.[illegible]45	1.41	2.[illegible]0	.217	.786	.362	.461	.531
	.467	.829E-01	2.36	2.03	1.69	.981	.839	.598
	[illegible].37	.613	2.61	2.76	1.55	[illegible].07	1.18	.887
PDLA - D LP	.444	.419	.385	.121	.491	2.28	.978	.251
	.407	.422	.451	.262	.347	1.67	1.65	.726
	.430	.423	.453	.282	.382	1.79	1.78	.789
PDC8 - D CO	-[illegible].97	-5.58	-.[illegible]54	3.31	-5.87	-7.97	-1.20	.643
	-[illegible].06	-5.61	-4.52	.943	-1.88	-7.24	-4.31	-.357E-01
	[illegible].44	5.62	4.67	1.76	3.25	7.28	4.66	.743
PDLA - D UP	-.468	-.784	-.496	-.669	-.446	.496	-.333E-01	-.511E-01
	-.645	-.652	-.586	-.571	-.477	.572	.111	-.413E-01
	.913	.661	.597	.594	.499	.614	.183	.485E-01
PDCA - C DC	-.256	-4.78	-1.04	.984	1.94	5.23	.920	.183
	-.237	-1.49	-3.01	-.506	2.43	3.33	3.81	.119E-01
	1.44	2.45	3.43	.952	2.58	3.58	4.12	.259
PDSA - D Se	-1.0A	-1.40	-1.09	-.549	-.736	-.282	-.172	-.167
	.520	-1.15	-1.12	-.801	-.972	.516E-01	-.368	-.388
	2.14	1.16	1.26	.858	1.01	.332	.384	.412
WF1A - AA02	-.102E-01	.116	.20[illegible]	.202	-.149	-.362	-.42[illegible]E-01	.440E-01
	-.136	.623E-01	.14[illegible]	.232	.143	-.369	-.186	.723E-02
	.183	.593E-01	.[illegible]42	.282	.217	.375	223	.683E-01
WF2A - AA03	-.2[illegible]4	.269E-01	.333	-.842	.520	.884	.680	.745
	-.397	-.144	.348	-.775	-.484	.332	.374	.484
	.471	.188	.[illegible]61	1.03	1.14	.650	.657	.490
WF3A - AA04	-.[illegible]7[illegible]	-.373	-.54[illegible]	-.654	-.346	-.555E-01	-.338	-.822
	-.[illegible]48	-.410	-.248	-.409	.129	-.265	-.421	-.783
	.[illegible]04	.418	.361	.562	.700	.351	.550	.806
WF4A - AA07	.708E-01	.734E-01	.3[illegible]8E-01	.208E-01	.751E-02	.345E-02	.881E-02	-.402E-02
	.931E-01	.712E-01	.[illegible]2E-01	.322E-01	.108E-01	.483E-02	.530E-02	.334E-02
	.188	.710E-01	.[illegible]52E-01	.324E-01	.121E-01	.641E-02	.651E-02	.719E-02
WF5A - AA10	-.232	-.371	-.295	1.41	.659	1.17	.840	.574
	.731	-.363	-.510	.628	1.38	.694	.851	.812
	.567	.384	.533	1.14	1.51	.734	.890	.933
WF6A - AA36	-2.1[illegible]	1.5[illegible]	-1.[illegible]	-1.47	-.140E-01	-.619	-.950E-02	-.218
	-[illegible].31	-.179	.560E-01	-1.02	-.893	-.328	-.201E-01	-.534E-01
	7.30	1.14	.887	1.36	1.10	.410	.195	.178
TF1A - T 3	[illegible].42	2.91	5.53	3.85	3.65	.888	-2.93	-11.6
	1.95	3.16	3.71	[illegible].97	3.40	1.37	-1.70	-6.25
	[illegible].00	3.39	3.81	6.07	3.41	1.99	1.89	6.78
TF2A - T 14	.250	-.690	.750	1.54	.530	.378	-4.18	-12.8
	-.417E-01	.282	1.17	1.11	1.36	1.15	-1.73	-8.49
	.750	.[illegible]80	1.32	1.18	1.74	1.34	2.40	8.91
TF4A - T 15	.960	2.42	1.41	1.71	1.23	.828	-8.66	-16.3
	1.26	1.70	1.66	1.25	1.20	1.15	-3.12	-11.7
	1.39	1.77	1.67	1.27	1.23	1.17	3.92	12.0
TF5A - T 31	1.63	[illegible].14	-.3[illegible]	-1.69	-1.93	-2.61	-1.88	-4.73
	1.32	6.42	3.40	-1.84	-1.99	-2.36	-2.44	-3.29
	1.1[illegible]	6.80	4.5[illegible]	1.71	2.02	2.38	2.53	3.42
TF6A - T 34	.968	2.31	1.35	-.780E-01	-1.25	-2.01	-1.63	-3.96
	.[illegible]9[illegible]	1.29	2.36	.317	-1.27	-1.91	-1.94	-2.72
	1.09	1.34	2.39	.548	1.36	1.92	1.96	2.89

BEST COPY AVAILABLE

- CODES -		- - - - TIME INTERVAL - - - -						
CALC.	EXP.	0.0 - 6.000	- 12.00	- 18.00	- 24.00	- 30.00	- 45.00	- 60.00	- 75.00
MT1A - TC 1		-4.08	-2.50	-1.84	-2.20	-2.34	-2.67	-1.31	-21.0
		-4.17	-3.43	-2.41	-2.15	-2.34	-2.31	-2.09	-7.02
		4.23	3.53	2.43	2.19	2.34	2.33	2.14	9.51
MT2A - TC 3		1.10	2.56	2.40	1.76	1.64	1.36	-.570	12.4
		1.04	2.00	2.11	1.68	1.44	1.32	1.20	.839
		2.08	2.02	2.13	1.88	1.45	1.34	1.33	6.70
MT3A - TC 5		-4.85	-2.54	-2.09	-1.72	-1.69	-1.68	-28.6	-31.9
		-4.02	-3.73	-2.23	-1.75	-1.74	-1.65	-6.84	-31.4
		4.03	3.80	2.24	1.78	1.75	1.65	10.8	31.4
MT4A - TC 9		-.850	-1.20	-1.08	-.838	-.198	-.138	-53.8	-50.8
		-1.39	-1.19	-1.08	-.869	-.632	-.117	-19.4	-56.6
		1.68	1.20	1.12	.995	.483	.197	26.8	56.6
MT5A - TC12		1.45	.470	.650	.448	.168	.888E-01	-38.9	-28.8
		.301	.914	.344	.268	.352E-01	.877E-01	-13.3	-33.4
		1.64	1.00	.421	.349	.219	.168	18.2	33.8
MT6A - TC15		1.46	.410	.640	.840	0.	-.880E-01	-34.9	-43.6
		.280	.574	.444	.217	.983E-01	-.543E-01	-15.6	-41.2
		1.60	.640	.588	.372	.330	.176	19.2	41.2
ML1A - X6A1		-35.0	-35.1	-34.8	-40.3	-45.2	-50.8	-50.1	-50.8
		-25.7	-34.9	-34.1	-35.9	-43.3	-47.3	-50.1	-50.4
		27.0	34.9	34.1	36.8	43.3	47.3	50.1	50.4
MP1A - X801		-.127	-.635E-01	-.148E-01	-.460E-01	.616E-02	.226E-02	-.670E-02	-.169E-01
		-.141	-.803E-01	-.386E-01	-.498E-02	-.194E-03	.481E-02	-.177E-02	-.119E-01
		.169	.844E-01	.488E-01	.655E-02	.373E-02	.493E-02	.316E-02	.122E-01

BEST COPY AVAILABLE

Case B

CONF CALCULATION-TO-EXPERIMENT DATA UNCERTAINTY ANALYSIS FOR NRC/ICAAP.

FIRST LINE : DIFFERENCE BETWEEN CALCULATED AND (AVERAGED) EXPERIMENTAL DATA AT END OF THE INTERVAL
SECOND LINE : MEAN DIFFERENCE OVER THE INTERVAL
THIRD LINE : MEAN SIGMA OVER THE INTERVAL (ROOT MEAN SQUARE OF THE DIFFERENCE)

- CODES -	- - - - TIME INTERVAL - - - -							
CALC. EXP.	0.0 - 6.000	- 12.00	- 18.00	- 24.00	- 30.00	- 45.00	- 60.00	- 75.00
P [illegible] - P [illegible]	-.550E-01	-.144E-01	-.123	-.749E-01	-.142	-.251	-.360	-.419
	-.853E-01	-.542E-01	-.421E-01	-.100	-.130	-.203	-.273	-.476
	.937E-01	.804E-01	.653E-01	.103	.132	.205	.276	.480
P [illegible] - P 4	-.615E-01	.144E-01	-.861E-01	-.460E-01	-.124	-.218	-.333	-.539
	-.622E-01	-.105E-01	-.391E-02	-.707E-01	-.103	-.173	-.264	-.457
	.691E-01	.243E-01	.536E-01	.745E-01	.106	.175	.248	.461
P 3[illegible] - P 6	-.960E-01	-.274E-01	-.116	-.527E-01	-.117	-.245	-.343	-.556
	.210	-.685E-01	-.479E-01	-.784E-01	-.111	-.184	-.256	-.468
	.744	.716E-01	.656E-01	.813E-01	.115	.187	.258	.472
PDL[illegible] - P 4	-2.78	.866	2.41	-1.68	.150	.924E-01	.304	-.968E-03
	-1.34	-1.38	1.75	1.64	.721	.413	.796	.159
	4.54	1.73	2.20	2.41	.983	.570	1.16	.680
PDL[illegible] - D LP	.443	.415	.291	-.131	.292	.225	.498E-01	-.789E-01
	.405	.414	.432	.418E-01	.682E-01	-.301	.218	-.268E-01
	.428	.419	.435	.254	.107	.575	.219	.447E-01
PDC[illegible] - D CO	-8.20	-11.3	-5.47	.640E-01	-5.88	-9.23	-8.23	.321
	-7.12	-9.05	-10.4	-1.83	-3.61	-7.75	-6.23	-.280
	8.18	9.96	10.6	2.97	4.13	7.85	6.67	.876
PDU[illegible] - D UP	-.714	-1.25	-1.19	-1.06	-.245	.819E-01	-.389E-01	-.724E-01
	-.787	-.995	-1.33	-1.13	-1.39	.311	-.238E-01	-.509E-01
	.987	1.01	1.33	1.13	1.51	.342	.581E-01	.556E-01
PC[illegible] - D DC	-.161	.654	-.108E-01	1.98	6.95	6.63	.917	.165
	-.183	1.19	-.210	.446	5.23	6.59	4.80	.250
	1.44	1.37	.652	.753	5.56	6.64	4.38	.297
PDU[illegible] - D 56	-1.54	-1.56	-1.47	-.946	-1.08	-.556	-.388	-.353
	-.158	-1.52	-1.96	-1.06	-1.84	-.638	-.672	-.493
	1.89	1.53	1.69	1.07	1.91	.673	.684	.508
WF1[illegible] - XA02	-.794E-01	.553E-01	.152	.144	-.807E-01	-.374	-.436E-01	.677E-01
	-.246	-.107E-02	.769E-01	.179	.874E-01	-.359	-.197	.296E-01
	.285	.325E-01	.841E-01	.186	.159	.365	.234	.595E-01
WF2[illegible] - XA03	-.646E-01	.571E-01	-.486E-01	.374	.944	.888	.485	.150
	.229	-.222E-01	.460	-1.28	.268	.429E-01	.348	.248
	.298	.933E-01	.523	1.57	1.22	.484	.598	.313
WF3[illegible] - XA04	-.231	-.189	-.674	-.694	-.216	.118E-01	-.524	-.829
	-.229	-.192	-.581	-.694	-.219	-.247	-.497	-.856
	.267	.192	.596	.710	.318	.353	.598	.871
WF5[illegible] - XA07	.705E-01	.739E-01	.183E-01	.801E-02	-.862E-02	-.251E-01	-.442E-01	-.728E-01
	.924E-01	.712E-01	.495E-01	.168E-01	-.351E-02	-.176E-01	-.384E-01	-.597E-01
	.140	.716E-01	.737E-01	.176E-01	.889E-02	.188E-01	.384E-01	.605E-01
WF4[illegible] - XA10	-1.11	-1.22	-.281	.987	-.657E-01	1.18	.852	.694
	-.578	-1.23	-1.27	.773	.247	.603	.936	.953
	.839	1.23	1.36	.948	.587	.721	.956	.965
WF4[illegible] - XA3A	-1.02	2.53	-1.17	-1.26	.174	-.470	-.229	-.427
	-4.24	.904	.789	-1.20	-.624	-.111	-.277E-01	-.233
	4.63	1.44	1.02	1.29	.897	.284	.190	.285
TF1[illegible] - T 3	2.44	2.90	7.98	2.17	1.98	-3.76	-9.73	-23.4
	1.96	3.17	5.28	5.84	2.02	-.938	-5.97	-15.6
	2.80	3.40	5.52	6.26	2.05	2.03	6.19	16.1
TF2[illegible] - T 14	-.308	-1.32	-.730	.440	-.920	-2.60	-11.0	-24.7
	-.257	-.248	.185	-.375E-02	.733E-02	-1.02	-5.87	-17.9
	.820	.561	.671	.478	1.09	1.28	6.45	18.3
TF4[illegible] - T 15	1.01	1.81	-.900E-01	.710	-.230	-2.17	-13.4	-28.1
	1.28	1.37	.715	.161	-.166	-1.05	-7.24	-21.0
	1.41	1.42	.883	.402	.388	1.17	7.90	21.5
TF1[illegible] - T 31	2.22	4.88	-1.76	-2.73	-3.58	-5.61	-7.89	-16.5
	1.17	7.63	2.64	-2.72	-3.38	-4.62	-6.66	-12.7
	1.33	8.02	4.48	2.74	3.60	4.66	8.67	12.9
TF2[illegible] - T 34	1.05	2.87	.420	-1.59	-2.89	-5.86	-8.58	-15.9
	.498	7.59	2.33	-.635	-2.80	-4.19	-6.19	-12.3
	1.08	1.66	2.46	1.02	2.85	4.72	6.28	12.5

BEST COPY AVAILABLE

- CODES -	- - - - TIME INTERVAL - - - -							
CALC. EXP.	0.0 - 6.000	- 12.00	- 18.00	- 24.00	- 30.00	- 48.00	- 60.00	- 75.00
MT1A - TC 1	-6.56	-2.58	-1.90	-2.02	-3.48	-5.51	-7.67	-20.4
	-6.13	-3.46	-2.41	-3.48	-3.51	-4.43	-5.95	-16.7
	4.19	3.61	2.03	3.54	3.54	4.47	5.99	15.8
MT2A - TC 3	1.44	2.37	.660	.930	.100E+00	-1.57	15.3	48.7
	2.65	2.08	1.45	.579	.443	-.784	.181	27.7
	2.68	2.07	1.58	.660	.566	.936	5.13	24.7
MT3A - TC 5	-4.21	-2.73	-3.28	-2.53	-2.81	-4.56	-.430	-2.20
	-4.53	-3.52	-2.93	-2.81	-2.94	-3.74	-4.88	-2.45
	4.44	3.56	2.96	2.83	2.95	3.77	4.32	2.51
MT4A - TC -	-1.27	-1.39	-2.87	-1.83	-1.51	-2.99	-22.6	-27.9
	-1.46	-1.30	-1.74	-1.84	-1.61	-2.14	-16.7	-25.3
	1.73	1.12	1.02	1.93	1.63	2.18	17.0	25.3
MT5A - TC12	1.03	.360	-.720	-.360	-1.18	-2.77	-8.77	4.18
	.494E-01	.719	-.635	-.639	-1.14	-1.93	-8.85	-1.82
	1.56	.756	.431	.711	1.17	1.98	9.94	4.97
MT6A - TC15	1.24	.379	-.150	.160	-1.42	-2.69	-27.4	-34.3
	.792	.620	.193	-.538	-.593	-2.84	-16.7	-32.3
	1.24	.655	.448	.419	1.03	2.88	18.9	32.3
ML1A - AA61	-22.8	-22.4	-18.1	-24.7	-28.1	-29.8	-29.9	-33.3
	-22.6	-25.1	-18.9	-26.3	-26.8	-28.4	-29.4	-31.7
	23.7	25.4	18.9	26.4	26.8	28.4	29.4	31.7
MP1A - AB01	-.127	-.435E-01	-.145E-01	-.648E-03	.616E-02	.224E-02	-.679E-02	-.169E-01
	-.141	-.803E-01	-.386E-01	-.498E-02	-.194E-03	.461E-02	-.177E-02	-.119E-01
	.140	.944E-01	.408E-01	.655E-02	.373E-02	.483E-02	.316E-02	.122E-01

BEST COPY AVAILABLE

Case C

CODE CALCULATION-TO-EXPERIMENT DATA UNCERTAINTY ANALYSIS FOR NRC/ICAAP.

FIRST LINE : DIFFERENCE BETWEEN CALCULATED AND (AVERAGED) EXPERIMENTAL DATA AT END OF THE INTERVAL
SECOND LINE : MEAN DIFFERENCE OVER THE INTERVAL
THIRD LINE : MEAN SIGMA OVER THE INTERVAL (ROOT MEAN SQUARE OF THE DIFFERENCE)

- CODES -		- - - - TIME INTERVAL - - - -						
CALC.	EXP.	0.0 - 6.000	- 12.00	- 18.00	- 24.00	- 30.00	- 45.00	- 60.00	- 75.00
P 1C	- P 1	-.554E-01 -.490E-01 .666E-01	.501E-01 .172E-02 .385E-01	.320E-02 .403E-01 .515E-01	.308E-01 .121E-01 .233E-01	-.266E-01 -.142E-01 .273E-01	-.875E-01 -.536E-01 .558E-01	-.887E-01 -.768E-01 .774E-01	-.327 -.192 .201
P 2C	- P 4	-.324E-01 -.172E-01 .221E-01	.894E-01 .401E-01 .594C-01	.324E-01 .729E-01 .819E-01	.329E-01 .348E-01 .384E-01	-.960E-02 .762E-02 .210E-01	-.568E-01 -.254E-01 .298E-01	-.627E-01 -.517E-01 .529E-01	-.246 -.174 .183
P 3C	- P 8	-.[illegible]E-01 .235 .746	.501E-01 -.108E-01 .390E-01	.111E-01 .414E-01 .485E-01	.561E-01 .327E-01 .431E-01	.280E-02 .758E-02 .279E-01	-.821E-01 -.335E-01 .391E-01	-.782E-01 -.599E-01 .618E-01	-.266 -.184 .194
PD4C	- D 4	-2.52 -1.14 5.46	1.37 -1.08 1.59	3.68 2.81 3.25	-.644 3.56 2.88	.972 1.40 1.47	.250 .956 1.05	.469 .827 1.17	.220 .336 .680
PDLC	- D LP	.444 .405 .429	.420 .421 .422	.394 .453 .454	.229 .368 .389	.572 .377 .402	1.43 1.45 1.53	.215 .555 .633	.173 .405E-01 .809E-01
PDCC	- D CO	-8.81 -8.91 7.94	-8.80 -8.99 8.99	.262 -4.88 5.67	5.04 3.62 4.17	-4.37 -.478 3.36	-8.56 -7.47 7.66	-2.06 -5.04 5.29	.454 -.210 .973
PDUC	- D UP	-.701 -.793 .935	-1.20 -.968 .903	-.598 -1.02 1.07	.112 -.374 .459	-.484 -.188 .486	.233 .581 .547	-.478E-01 .376E-01 .966E-01	-.622E-01 -.457E-01 .504E-01
PDFC	- D DC	-.160 -.161 1.66	-17.8 -5.17 7.96	-6.03 -13.6 14.5	-2.16 -3.51 3.65	.744 -.190 1.11	6.03 2.50 3.54	.764 3.96 4.35	-.147 -.127 .273
PDSC	- D SG	-1.60 -.233 1.82	-1.64 -1.53 1.54	-1.11 -1.74 1.80	-.357 -.738 .766	-.330 -.301 .694	-.459 .704E-01 .427	-.375 -.412 .425	-.252 -.467 .484
WF1C	- A402	-.723E-01 -.248 .288	.849E-01 .111E-01 .408E-01	.196 .147 .155	.282 .299 .314	-.231 .168 .297	-.383 -.358 .364	-.606E-01 -.192 .227	.464E-01 .103E-01 .485E-01
WF2C	- A403	.319E-01 -.164 .244	.735 .223 .306	.747 1.05 1.06	-1.10 -.642 .963	-.287 -.471E-01 1.06	.452 .593 .793	.669 .434 .629	.564 .577 .698
WF3C	- A404	-.281 -.206 .249	-.446E-01 -.129 .133	.387 .369 .439	-.673 -.316 .389	.524E-01 -.323E-01 .523	.100 -.737E-01 .255	-.402 -.619 .528	-.731 -.799 .817
WF5C	- A407	.785E-01 .934E-01 .161	.739E-01 .712E-01 .716E-01	.352E-01 .588E-01 .802E-01	.235E-01 .346E-01 .342E-01	.795E-02 .118E-01 .133E-01	-.608E-04 .445E-02 .681E-02	-.231E-02 -.482E-03 .203E-02	-.288E-01 -.163E-01 .163E-01
WF4C	- A410	-1.17 -.585 .845	-1.13 -1.22 1.22	-.779E-01 -.868 1.00	1.16 .823 1.15	.171 .622 .887	.983 .625 .685	.801 .643 .888	.742 .926 .933
WF6C	- A436	-.960 -4.23 6.62	2.39 .962 1.48	-.960 1.03 1.23	-1.20 -.630 1.15	.244 -.599 .840	-.378 -.207E-01 .260	-.587E-01 .151 .235	-.327 -.102 .192
TF1C	- T 3	2.45 1.96 2.01	2.98 3.21 3.44	4.13 3.57 3.80	3.80 4.44 4.45	3.78 3.52 3.53	-1.23 1.38 5.03	-4.35 -2.45 2.57	-15.8 -9.08 9.65
TF2C	- T 14	.288E-01 -.138E-01 .725	-.620 .220 .572	.648 1.02 1.17	1.78 1.29 1.37	.578 1.48 1.84	-.168E-01 1.13 1.31	-5.59 -2.38 3.02	-16.8 -11.7 11.8
TF4C	- T 15	1.23 1.50 1.61	2.50 1.80 1.98	1.25 1.55 1.58	2.00 1.42 1.44	1.27 1.35 1.39	.400 1.12 1.15	-8.07 -3.75 4.54	-20.3 -14.5 14.9
TF3C	- T 31	2.31 1.21 1.38	5.60 6.33 6.56	-.290 2.76 3.48	-1.36 -1.36 1.41	-1.87 -1.82 1.85	-3.03 -2.76 2.39	-2.39 -3.09 3.13	-8.67 -8.12 8.32
TF5C	- T 34	1.07 .418 1.09	2.80 1.61 1.68	2.37 2.53 2.54	-.220 .862 1.12	-1.42 -1.27 1.37	-2.65 -1.98 2.01	-3.15 -2.66 2.67	-8.07 -5.66 5.98

BEST COPY AVAILABLE

- CODES -		- - - - TIME INTERVAL - - - -						
CALC. EXP.	0.0 - 6.000	- 12.00	- 18.00	- 24.00	- 30.00	- 45.00	- 60.00	- 75.00
MT1C - TC 1	-4.45	-2.22	-2.92	-2.03	-2.31	-2.97	-2.44	-24.7
	-5.94	-3.07	-2.64	-2.59	-2.24	-2.30	-2.68	-9.58
	4.03	3.20	2.70	2.62	2.28	2.32	2.70	11.9
MT2C - TC 3	1.69	2.48	1.79	1.94	1.49	.980	-1.83	27.9
	2.58	2.44	2.04	1.71	1.72	1.34	.677	15.3
	2.77	2.45	2.09	1.72	1.73	1.36	.786	17.4
MT3C - TC 5	-4.11	-2.18	-2.15	-1.46	-1.44	-2.88	-16.1	-16.6
	-4.30	-3.17	-2.28	-1.71	-1.66	-1.63	-6.58	-15.7
	4.54	3.24	2.38	1.73	1.67	1.84	9.29	15.7
MT4C - TC 9	-.960	-.670	-1.75	-.620	-.160	-.450	-42.1	-45.7
	-1.43	-.805	-1.01	-.870	-.322	-.898E-01	-19.2	-42.2
	1.52	.860	1.13	1.00	.361	.200	25.2	42.3
MT5C - TC12	1.30	1.04	.138	.458	.198	-.258	-28.2	-13.4
	.282	1.21	.408	.245	.136	.111	-13.1	-18.4
	1.41	1.22	.658	.338	.264	.209	17.4	19.8
MT6C - TC15	1.38	.860	.480	.878	.488E-01	-.320	-31.7	-35.9
	.467	.949	.514	.223	.187	-.555E-01	-16.8	-33.2
	1.55	.960	.785	.368	.358	.202	19.4	33.2
ML1C - X661	-28.6	-21.9	-15.7	-18.8	-21.9	-22.3	-19.7	-21.2
	-22.6	-25.0	-17.8	-15.4	-20.9	-21.6	-20.7	-20.5
	23.6	25.0	17.9	15.5	20.9	21.6	20.8	20.5
MP1C - X801	-.127	-.635E-01	-.145E-01	-.440E-03	.616E-02	.224E-02	-.670E-02	-.169E-01
	-.161	-.803E-01	-.366E-01	-.498E-02	-.194E-03	.461E-02	-.177E-02	-.119E-01
	.160	.844E-01	.408E-01	.655E-02	.373E-02	.483E-02	.316E-02	.122E-01

BEST COPY AVAILABLE

Case D

CODE CALCULATION-TO-EXPERIMENT DATA UNCERTAINTY ANALYSIS FOR NRC/ICAP.

FIRST LINE : DIFFERENCE BETWEEN CALCULATED AND (AVERAGED) EXPERIMENTAL DATA AT END OF THE INTERVAL
SECOND LINE : MEAN DIFFERENCE OVER THE INTERVAL
THIRD LINE : MEAN SIGMA OVER THE INTERVAL (ROOT MEAN SQUARE OF THE DIFFERENCE)

- CODES -		- - - - TIME INTERVAL - - - -						
CALC.	EXP.	0.0 - 4.000	- 12.00	- 18.00	- 24.00	- 30.00	- 45.00	- 60.00	- 75.00
P 1	P 3	-.938E-02	.193	.153	.131	-.227E-01	-.383	-.425	-.784
		-.491E-01	.941E-01	.102	.153	.360E-01	-.168	-.354	-.556
		.593E-01	.114	.104	.153	.620E-01	.187	.355	.560
P 20	P 4	.137E-01	.223	.100	.152	-.630E-02	-.272	-.390	-.624
		-.6A3E-02	.139	.214	.173	.588E-01	-.140	-.329	-.528
		.238E-01	.152	.216	.174	.758E-01	.162	.338	.542
P 40	P 4	-.205E-01	.184	.156	.156	.121E-01	-.295	-.404	-.649
		.266	.812E-01	.163	.174	.586E-01	-.146	-.336	-.545
		.765	.103	.184	.176	.776E-01	.169	.337	.549
PD40	D 4	-2.51	1.38	4.10	-.604	.960	.176	.584	.236
		-1.07	-1.10	2.95	2.26	1.19	.982	.798	.437
		5.43	1.80	3.41	2.68	1.31	1.05	1.16	.725
PDLP	D LP	.442	.416	.412	.387	.536	1.62	.534	.547E-01
		.405	.419	.448	.378	.238	1.53	.818	.229
		.428	.419	.469	.377	.299	1.61	.898	.278
PDCO	D CO	-8.75	-8.71	2.74	5.60	-4.42	-8.96	-2.29	.351
		-6.81	-8.94	-4.20	5.77	-1.21	-7.47	-5.47	-.318
		7.85	8.94	5.42	5.97	3.02	7.71	5.78	.981
PDUP	D UP	-.A99	-1.21	-.631	.611	-.502	.201	-.577E-01	-.751E-01
		-.798	-.968	-1.07	-.141	-.170	.482	.871E-02	-.576E-01
		.981	.984	1.11	.665	.698	.531	.799E-01	.615E-01
PDPC	D PC	-.870E-01	-17.8	-7.74	-4.39	-1.13	5.77	.685	.148
		-.138	-5.44	-14.6	-5.67	-2.78	1.64	3.89	-.388E-01
		1.68	7.90	15.3	6.02	3.34	3.03	4.28	.249
PDSC	D SC	-1.83	-1.66	-1.18	.220	-.142	-.471	-.437	-.343
		-.210	-1.56	-1.83	-.521	-.264	.861E-01	-.496	-.503
		1.84	1.57	1.87	.658	.380	.436	.507	.514
MF1C	A602	-.702E-01	.868E-01	.242	.282	-.210	-.425	-.627E-01	.403E-01
		-.237	.119E-01	.156	.278	.929E-02	-.360	-.201	.740E-02
		.277	.413E-01	.186	.283	.188	.366	.237	.483E-01
MF2C	AA03	.252E-01	.787	.653	-.194	-.615	-.242	.838	.434
		-.171	.287	.596	-.826	-.255	.552	.518	.611
		.264	.291	1.01	1.08	1.25	.729	.674	.688
MF3C	AA04	-.206	-.A74E-01	-.195	-.132	.488	.253	-.386	-.834
		-.214	-.138	.182	-.368	.186	.118	-.387	-.760
		.254	.140	.428	.487	.283	.388	.512	.788
MF4C	A607	.705E-01	.739E-01	.596E-01	.399E-01	.868E-02	-.363E-01	-.536E-01	-.851E-01
		.934E-01	.712E-01	.795E-01	.567E-01	.206E-01	-.131E-01	-.431E-01	-.707E-01
		.161	.716E-01	.990E-01	.570E-01	.234E-01	.194E-01	.433E-01	.715E-01
MF4C	A610	-1.11	-1.12	-.620	.990	.845	1.09	1.05	.550
		-.562	-1.23	-.898	.988	.668	.803	.832	.804
		.831	1.23	.954	1.28	.532	.830	.876	.840
MF6C	A636	-.992	2.57	-.751	-1.21	.298	-.388	.560E-02	-.241
		-.2A	.987	.887	-.791	-.588	-.117E-01	.148	-.676E-01
		4.44	1.48	1.13	1.17	.838	.264	.232	.182
TF1C	T 3	2.58	3.28	4.26	5.34	3.77	-4.65	-11.1	-25.9
		2.01	3.42	3.98	4.61	4.32	-.488	-7.44	-17.7
		2.06	3.84	3.93	4.62	4.37	2.66	7.63	18.2
TF2C	T 14	.390	.738	2.24	2.98	.620	-3.66	-12.3	-27.1
		.537E-01	.920	2.47	2.87	2.12	-.588	-7.38	-19.9
		.729	1.11	2.53	2.91	2.43	1.43	7.87	20.4
TF4C	T 15	1.63	3.75	2.65	3.24	1.33	-3.63	-14.8	-38.6
		1.58	2.75	3.08	3.62	2.88	-.585	-8.75	-23.1
		1.61	2.82	3.01	3.83	2.89	1.39	9.41	23.5
TF3C	T 31	3.89	8.25	1.33	-.139	-1.83	-6.63	-9.14	-19.8
		1.67	8.35	4.66	.273	-1.15	-4.85	-8.89	-14.7
		1.69	8.64	5.30	.681	1.32	4.27	8.15	14.9
TF4C	T 34	1.75	4.85	4.03	.920	-1.28	-5.83	-9.77	-18.3
		.893	2.82	5.14	2.53	-.868	-3.63	-7.59	-14.2
		1.44	2.95	5.15	2.71	1.01	3.87	7.85	14.4

BEST COPY AVAILABLE

- CODES -		- - - - TIME INTERVAL - - - -						
CALC. EXP.	0.0 - 6.000	- 12.00	- 18.00	- 24.00	- 30.00	- 45.00	- 60.00	- 75.00
MT1D - TC 1	-4.35	-1.15	-1.43	-.788	-2.05	-4.16	-8.70	-3.03
	-.91	-2.34	-1.36	-1.31	-1.43	-3.72	-7.36	-8.53
	.99	2.61	1.42	1.38	1.54	3.94	7.30	8.92
MT2D - TC 2	1.89	3.98	3.29	3.29	1.89	-2.27	-.948	27.6
	2.63	3.16	3.37	3.90	2.51	-.153	-3.38	15.4
	2.40	3.19	3.39	3.21	2.57	1.71	3.99	17.1
MT3D - TC 5	-3.84	-1.09	-.698	-.188	-1.24	-5.26	-13.5	-15.6
	-4.35	-2.46	-.944	-.185	-.855	-3.13	-9.52	-14.8
	4.58	2.61	.993	.382	.947	3.33	10.6	14.8
MT4D - TC 9	-.649	.610	-.188	.728	.788E-01	-3.67	-37.9	-43.7
	-1.34	.931E-01	.342	.609	.489	-1.57	-21.8	-30.9
	1.46	.515	.526	.765	.850	1.91	20.1	40.8
MT5D - TC12	1.62	2.11	1.65	1.71	.490	-3.46	-23.7	-11.2
	.352	1.92	1.77	1.69	.938	-1.36	-15.7	-16.8
	1.47	1.93	1.81	1.78	1.84	1.77	18.4	16.4
MT6D - TC15	1.43	1.95	1.94	2.15	.298	-3.48	-33.4	-36.9
	.516	1.64	1.86	1.74	1.03	-1.47	-20.8	-35.8
	1.48	1.65	1.98	1.76	1.18	1.87	22.8	35.8
ML1D - AA01	-24.8	-22.0	-16.7	-20.8	-23.9	-24.1	-21.6	-22.5
	-22.7	-25.1	-18.2	-17.1	-22.8	-23.3	-22.7	-22.1
	23.7	25.2	18.3	17.1	22.9	23.3	22.7	22.1
MP1D - AA01	-.127	-.435E-01	-.148E-01	-.440E-03	.610E-02	.224E-02	-.679E-02	-.169E-01
	-.141	-.803E-01	-.386E-01	-.498E-02	-.194E-03	.461E-02	-.177E-02	-.119E-01
	.149	.944E-01	.408E-01	.655E-02	.373E-02	.483E-02	.316E-02	.122E-01

BEST COPY AVAILABLE

P 1A	PRESSURE LOWER PLENUM (P 3101) CASE A
P 2A	PRESSURE, UPPER PLENUM (P 5201) CASE A
P 3A	PRESSURE, BREAK INLET (P 9601) CASE A
PD4A	DIFF PRESSURE, CORE INLET RESTRICTION (P 3301 - P 401) CAS
PDCA	DIFF PRESSURE, CORE (FROM P 401 - P 5101) CASE A
PDDA	DIFF PRESSURE, DOWNCOMER (FROM P 710[illegible] - P 7201) CASE A
PDLA	DIFF PRESSURE, LOWER PLENUM (FROM P 3101 - P 3301) CASE A
PDUA	DIFF PRESSURE, UPPER PLENUM (FROM P 5101 - P 5201) CASE A
PDSA	DIFF PRESSURE, STEAM SEPARATOR ORIFICE (P 5201 - P 5202) C
TSUA	SUBCOOLING, BREAK INLET (TEMPB 9101 - TEMPF 9101) CASE A
WP1A	CORE HEATING POWER (CNTRLVAR 57) CASE A
WL1A	HEAT LOSS FROM PASSIVES (CNTRLVAR 53) CASE A
WF1A	MASS FLOW RATE, BYPASS (MFLOWJ 117) CASE A
WF2A	MASS FLOW RATE, I.L. PUMP (MFLOWJ 20102) CASE A
WF3A	MASS FLOW RATE, B.L. PUMP (MFLOWJ 20202) CASE A
WF4A	MASS FLOW RATE, B.L. VESSEL INLET (MFLOWJ 9702) CASE A
WF5A	MASS FLOW RATE, STEAM RELIEF (MFLOWJ 404) CASE A
WF6A	MASS FLOW RATE, BREAK (MFLOWJ 152) CASE A
RH1A	FLUID DENSITY, CORE BOTTOM (RHO 0401) CASE A
RH2A	FLUID DENSITY, VESSEL BOTTOM (RHO 3101) CASE A
RH3A	FLUID DENSITY, BREAK (RHO 9601) CASE A
HT1A	MEAN CLAD TEMPERATURE, LEVEL 1 (HTTEMP 401000105) CASE A
HT2A	MEAN CLAD TEMPERATURE, LEVEL 3 (HTTEMP 403000105) CASE A
HT3A	MEAN CLAD TEMPERATURE, LEVEL 5 (HTTEMP 404000105) CASE A
HT4A	MEAN CLAD TEMPERATURE, LEVEL 9 (HTTEMP 406000105) CASE A
HT5A	MEAN CLAD TEMPERATURE, LEVEL 12 (HTTEMP 407000105) CASE A
HT6A	MEAN CLAD TEMPERATURE, LEVEL 15 (HTTEMP 410000105) CASE A
TF1A	FLUID TEMPERATURE, CORE INLET (TEMPF 3301) CASE A
TF2A	FLUID TEMPERATURE, CORE OUTLET (TEMPF 5101) CASE A
TF3A	FLUID TEMPERATURE, DOWNCOMER BOTTOM (TEMPF 7108) CASE A
TF4A	FLUID TEMPERTURE, UPPER PLENUM (TEMPF 5201) CASE A
TF5A	FLUID TEMPERTURE, BREAK INLET (TEMPF 9601) CASE A
CPUA	CPUTIME CASE A
MATA	TOTAL MASS, IN SYSTEM CASE A
MAEA	MASS ERROR CASE A
ML1A	BREAK TOTAL MASS LOSS (CNTRLVAR 55) CASE A

P 3	PRESSURE, LOWER PLENUM (PT 3) - EXPERIMENT
P 4	PRESSURE, UPPER PLENUM (PT 4) - EXPERIMENT
P 6	PRESSURE, BREAK INLET (PT 6) - EXPERIMENT
D 4	DIFF. PRESSURE, CORE INLET RESTRICTION (DPT 4) - EXPERIMENT
D 56	DIFF. PRESSURE, STEAM SEPARATOR ORIFICE (DPT 56) - EXPERIME
D LP	DIFF. PRESSURE, LOWER PLENUM (DPT 2 + DPT 3 - DPT 1) - EXPE
D CO	DIFF. PRESSURE, CORE (DPT 5 + DPT 6 + ... + DPT 12) - EXPE
D UP	DIFF. PRESSURE, UPPER PLENUM (DPT 13 + DPT 14) - EXPERIMENT
D DC	DIFF. PRESSURE, DOWNCOMER (DPT 27 + ... + DPT 30) - EXPERI
X602	MASS FLOW RATE, BYPASS (CALCULATED) - EXPERIMENT
X603	MASS FLOW RATE, I.L. PUMP (CALCULATED) - EXPERIMENT
X604	MASS FLOW RATE, B.L. PUMP (CALCULATED) - EXPERIMENT
X607	MASS FLOW RATE, STEAM RELIEF (CALCULATED) - EXPERIMENT
X610	MASS FLOW RATE, B.L. VESSEL INLET (SPOOL PIECE K10) - EXPER
X63A	MASS FLOW RATE, BREAK FROM T2 INVENTORY (CALCULATED) - EXPE
X661	MASS LOSS, BREAK FLOW RECIEVER (CALCULATED) - EXPERIMENT
X801	ELECTRIC POWER, CORE (CALCULATED) - EXPERIMENT
T 3	FLUID TEMPERATURE, CORE INLET (TE 3) - EXPERIMENT
T 14	FLUID TEMPERATURE, CORE OUTLET (TE 14) - EXPERIMENT
T 15	FLUID TEMPERATURE, UPPER PLENUM (TE 15) - EXPERIMENT
T 31	FLUID TEMPERATURE, DOWN COMER BOTTOM (TE 31) - EXPERIMENT
T 34	FLUID TEMPERATURE, BREAK INLET (TE 34) - EXPERIMENT
TC 1	MEAN CLAD TEMP., LEVEL 1 (T191 T206 T211 T246) - EXPERIMENT
TC 3	MEAN CLAD TEMP., LEVEL 3 (T188 T183 T243 T248) - EXPERIMENT
TC 5	MEAN CLAD TEMP., LEVEL 5 (T202 T227 T232 T237 T252) - EXPER
TC 9	MEAN CLAD TEMP., LEVEL 9 (T102 T137 T167 T172 T187 T197 T27
TC12	MEAN CLAD TEMP., LEVEL 12 (T118 T123 T128 T148 T223) - EXPE
TC15	MEAN CLAD TEMP., LEVEL 15 (T175 T190 T275) - EXPERIMENT

BEST COPY AVAILABLE

NRC FORM 335 (2-84) NRCM 1102, 3201, 3202

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

SEE INSTRUCTIONS ON THE REVERSE

1 REPORT NUMBER (Assigned by TIDC, add Vol No., if any)
NUREG/IA-0005
STUDSVIK/NR-85/99

2 TITLE AND SUBTITLE
Assessment of RELAP/MOD2, Cycle 36, Against FIX-II Split Break Experiment No. 3027

3 LEAVE BLANK

4 DATE REPORT COMPLETED
MONTH | YEAR

5 AUTHOR(S)
John Eriksson

6 DATE REPORT ISSUED
MONTH: September | YEAR: 1986

7 PERFORMING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code)
Swedish Nuclear Power Inspectorate
P. O. Box 27106
S102 #52 Stockholm, Sweden

8 PROJECT/TASK/WORK UNIT NUMBER

9 FIN OR GRANT NUMBER

10 SPONSORING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code)
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, DC 20555

11a TYPE OF REPORT
Technical
b PERIOD COVERED (Inclusive dates)

12 SUPPLEMENTARY NOTES

13 ABSTRACT (200 words or less)

The FIX-II split break experiment No. 3027 has been analyzed using the RELAP5/Mod2 code. The code version used, Cycle 36, is a frozen version of the code.

Four different prediction calculations were carried out to study the sensitivity on various parameters to changes of break discharge, initial coolant mass, and passive heat structures. The differences between the calculations and the experiment have been quantified over intervals in real time for a number of variables available from the measurements during the experiment.

The core inventory expressed by the differential pressure over the core was generally underpredicted. Dryout times were generally overpredicted, probably due to differences in the used dryout correlation.

14 DOCUMENT ANALYSIS - a KEYWORDS/DESCRIPTORS
RELAP5/MOD2
FIX-II
ICAP Code Assessment

b IDENTIFIERS/OPEN ENDED TERMS

15 AVAILABILITY STATEMENT
Unlimited

16 SECURITY CLASSIFICATION
(This page) Unclassified
(This report) Unclassified

17 NUMBER OF PAGES

18 PRICE

BEST COPY AVAILABLE